POWER

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FRED R. LOW, *Editor*

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Give the Engineer a Chance

MEN win their way to executive positions because they know how to make the difference between failure and success.

The seemingly exorbitant salaries paid to some are justified on the ground that they produce returns that warrant them.

His emolument, large as it may seem, may be a small proportion of the increased earnings produced by one who visualizes the possibilities and knows how to get them realized.

May it not be just as effective to invest in plant as in men?

Many power plants are in the position today of businesses that are "in the red" or are just getting along.

They keep the works going, and that is where the interest of managements ceases.

The engineer may not be competent to manage the business or the factory, but he can often show how his department could be rehabilitated and run so as to make a profit on the required investment commensurate with that which the expensive executive makes on that of the whole works.

The Big Boss has his way. When he knows of another thing that ought to be done to increase profits he is usually in a position to have it done. By and large his moves must be successful or he would not last.

But many an engineer, knowing the inefficiency of his plant, conscious of the potentiality of the tremendous advances that have been made in power plant apparatus and practice in a score of years, is powerless to put his ideas into effect, to realize his vision of the possibilities of the application of modern appliances and methods to his own case.

Have you read the instances that *Power* is constantly describing of rehabilitated plants that pay for themselves in a few years and go on making a handsome profit for their owners?

The number of plants that offer opportunity for such treatment is legion. It is regrettable that their engineers, knowing their possibilities, do not put their cases over more convincingly.

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

Good Intentions And Smoking Chimneys

IT IS a heartening thought that the intentions of most men are generally the best; but the cheerfulness arising from this is too often neutralized by the realization that these intentions frequently are not fulfilled.

A foggy morning such as that on which these words are written serves to emphasize this lack of fulfillment. At least a hundred stacks are visible from the windows of *Power's* editorial offices. With but few exceptions each of these is belching forth clouds of black smoke, adding to the murky pall that already enshrouds the city of New York.

Without doubt, no single engineer responsible for these smoking chimneys is deliberately adding to the discomfort of his fellow citizens. Most would unquestionably be amazed to learn that their plants are a public nuisance and a menace to health. They are simply too busy with their multitudinous duties to spend time on a matter that has never been impressed upon them as important.

The true responsibility for the condition must rest on the plant owners and the municipal government. When public authorities clearly demonstrate the need for smoke abatement to plant executives and building owners these men will undoubtedly do their share. There will be few, in the long run, with whom it will be necessary to adopt forcible methods. Both parties will find power engineers eager to co-operate when the facilities for smoke abatement are made available.

What Makes A Backward Industry?

EVERYTHING in life depends on the point of view, which is one way of saying that John Smith might consider an industry very progressive, while Henry Jones would be equally convinced that it was backward. Both might be right.

For instance, a member of the *Power* staff recently visited a large plant that turns out the highest grade product in its line. Factory equipment and layout were of the best, and engineering skill of a high order was evident throughout the production activities that were seen. However, on entering the power house, the picture changed. A battery of hand-fired boilers that Mr. Ford would covet for his museum of engineering antiquities made steam for an engine that might well have been at one time the pride of the Centennial exhibit. It was admitted that this outfit was perhaps a bit behind the times and that power might be secured more cheaply from a modern plant. But the old equipment was reliable and the management was loath to scrap it as long as it would run.

Not thirty miles from this horrible example there is another plant where the conditions are reversed. The manufacturing end of this concern is a chaotic wilderness through which the workmen themselves have difficulty in finding their way. The production equipment is a nightmare mixture of good, bad and indifferent. The power house, however, is a marvel of modern engineering skill and supplies the factory with power services with high economy.

Which of these plants is backward? Both, of course. It is poor management to have one part of the plant completely out of line with the remainder. And when one finds a whole industry, such as actually exists today, in which the production equipment and facilities are of the best while power problems are neglected, there is nothing else to do but label that industry backward.

Two Great Contributions To the Welding Art

MANY valuable contributions to the welding art were made by the papers presented in Cleveland last week at the Fall meeting of the American Welding Society, but two stand out as uniquely significant. These papers are "Non-Destructive Testing of Welds," by Elmer A. Sperry, and "Non-Destructive Testing of Welds by Means of Stethoscope and X Ray," by A. B. Kinzel, C. O. Burgess and A. R. Lytle. The first is the product of an organization centering around the genius of a great inventor; to complete the picture, the second comes as still another demonstration of the productivity of the large well-manned industrial laboratory. Messrs. Kinzel, Burgess and Lytle are on the staff of the Union Carbide & Carbon Research Laboratory, which has already made frequent and notable contributions to the art of welding.

A little background is needed for the full appreciation of these papers. For some years the progress of the welding industry has been very definite and rapid, yet this progress has been made in the face of one objection raised on every occasion by the conservatives. The constant refrain "You can't tell whether a weld is strong or not except by breaking it" has undoubtedly had some effect on engineering thought. A demand arose for non-destructive tests, but leaders in the welding industry were not at all sure that such tests could be developed, and therefore confined most of their attention to matters of proper design, supervision, training of welders and procedure control as the technique of insuring sound welds. Tremendous progress has been made along these

lines, and it is undoubtedly true today that welding operations, properly organized from the top down, are so trustworthy that non-destructive tests are unnecessary.

Nevertheless, it is realized that some will attempt welding of importance without proper organization and that simple and reliable non-destructive tests would be of immense value as a court of last resort.

Therefore, when such an individual as Elmer Sperry and such a scientific organization as the Union Carbide & Carbon Research Laboratory come forward simultaneously with different, but apparently equally effective, non-destructive tests the event is real news in the industrial world. Those interested in the methods used may find them explained briefly in this issue of *Power*. It may be said here that Sperry's is an adaptation of his electrical resistance method of testing rails while in use. The test brought forward by Messrs. Kinzel, Burgess and Lytle involves the stethoscope and X ray. Engineers studying these papers will find, perhaps, certain limitations to these tests, but none can deny that an immense forward step has been taken.

Meters Essential To Good Building Operation

LARGE office buildings, department stores, hotels and other public buildings offer opportunities for the use of meters and comprehensive record systems equal to many large industrial plants. Contrary to the general belief, large buildings have heating and power requirements comparable to these services in manufacturing plants. Unless a careful check is kept on each and every service the avoidable losses may run into large figures.

Good operation requires the extensive use of meters, which should be read daily, reports compiled and the records carefully checked for unusual operating conditions. By doing this, defects that may develop into serious trouble at an unexpected time will be detected when they first occur and when they can be repaired at small expense.

A pump or a blower may be in a condition that will greatly increase the power consumption, but to all outward appearances may be all right. Daily watt-hour meter readings will show these defects when they first appear. On the ventilating system the fans can be operated on a prearranged schedule, and daily watt-hour meter readings on each fan will show how closely the schedule is being followed. Some building engineers are finding it advantageous to use a watt-hour meter on each elevator machine. These records, along with car-mileage and the number of stops, tell a complete story of how the elevators are being operated.

The time required to read the meters and compile the records is sometimes considered an unnecessary expense. But a good record clerk and proper use of the records can easily replace a repair man, reduce repair, power and other costs and improve the service rendered. In addition the meters give a check on the attendant and machines that cannot otherwise be obtained.

Thermal Efficiencies

FOR several years prior to 1922 the over-all thermal efficiencies obtained by the best central stations remained close to 17.5 per cent. During the next four years improved plant design, higher pressures and temperatures and new steam cycles raised the thermal efficiencies of the best plants to about 25 per cent, a yearly increase of 10 per cent. The last two and a half years have witnessed an apparent slowing up in the rate of improvement of plant efficiencies. The best all-steam plants today do not produce a kilowatt for better than about 12,600 B.t.u., representing an efficiency of 27 per cent, an increase of only 7.4 per cent in two and a half years. This, of course, does not include the mercury vapor cycle, with which considerably better economy is obtainable but which is still in an experimental stage.

Some further increase is to be expected from higher-pressure and temperature plants now under construction, but the apparent slowing up in the rate of efficiency improvement would seem to indicate that the maximum efficiencies with steam will soon be reached and that further improvement will depend upon binary vapor cycles or the invention of some new process of power generation.

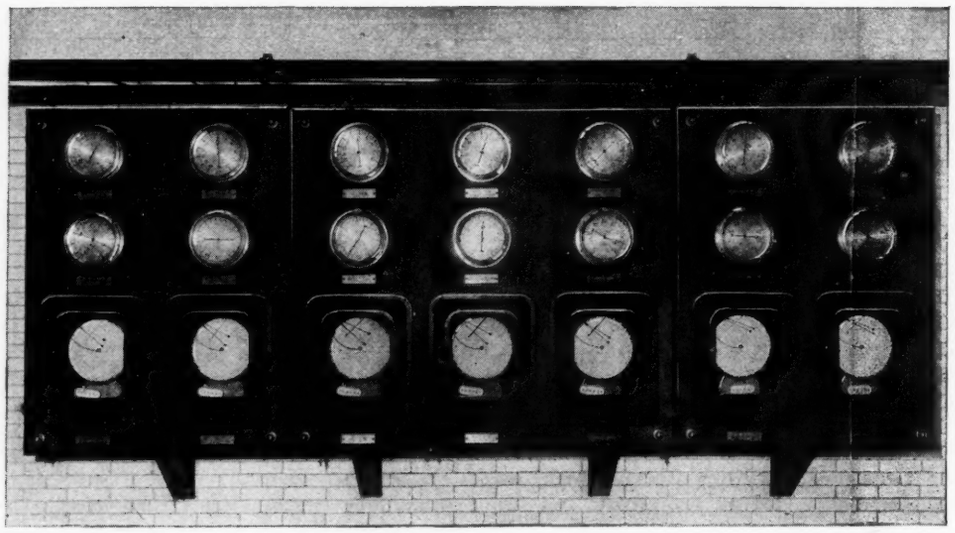
Maine Continues to Ban Power Export

FOR many years Maine, alone of the states, has forbidden the export of power beyond her borders. From time to time attempts have been made to change this situation, and the Charlton bill, which passed the Legislature and came up for popular referendum last week, was thought to contain enough safeguards to insure its adoption. Among these was a provision for licensing by the State Public Utilities Commission, which was empowered to fix rates and levy an export tax based on gross revenues. Also, if the power was needed within the state, the commission could revoke the permit of any company.

In spite of these apparent safeguards the vote of the rural population was decisively against power export, and the bill suffered defeat. Perhaps the bogy of a "power trust" had something to do with the result, or it may have been that overzealousness on the part of those pushing the bill created suspicion.

From an economic standpoint the result is unfortunate. Maine ranks high in potential water power among the eastern states; and although much of this power has been developed, industry within the state does not warrant its maximum development. Moreover, by taking advantage of present practice in long-distance interconnection of systems, more efficient use could be made of the excess power.

It would seem that Maine has more to lose than to gain by adhering to a policy of isolation in power matters.



Meter panel in the boiler room

Meters REDUCE OPERATING COSTS *in Office Buildings*

By F. A. ANNETT
Associate Editor, *Power*

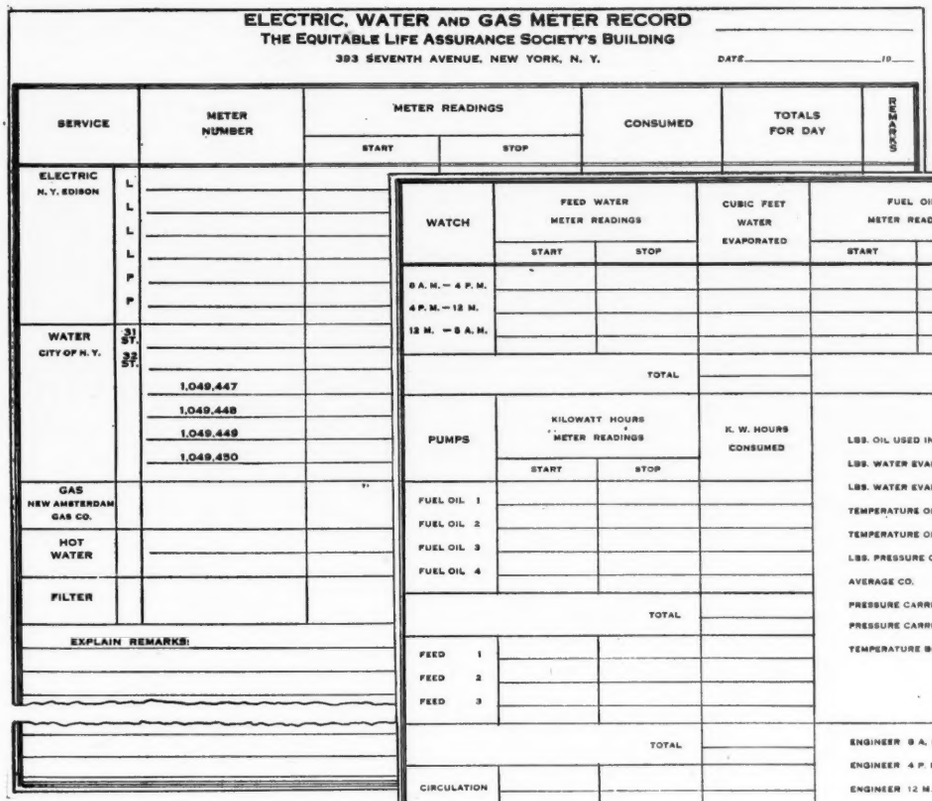
DO METERS PAY? *is a question often asked. The answer is: Yes, if proper use is made of the story they tell, as is done in the Equitable Assurance Society's Building, New York City. In this building over 460 meters for all purposes are used, and complete records are kept of operation. The meter records have proved to be an efficient means of keeping down operating costs and detecting sources of trouble in equipment before they develop into failures.*

SUPPLYING power, heat, water and other services to large office or other classes of buildings involves large expenditures. Even when power is not generated the fuel bill is a large one, and unless careful check is kept on the heating plant's operation a large item of excessive cost may occur there. Lack of proper control of the heating system and inattention to room temperatures may cause large losses from that source.

Improper elevator schedules, inefficient operators and poorly maintained elevator equipment may not only cause unsatisfactory elevator service to the tenants but may increase the cost of this service by excess power consumption and in other ways. Ventilating fans operated when they are not required or run at unnecessarily high speed, increase the power consumption beyond that required to render the proper service. These and other sources afford opportunity for waste of fuel, heat and power that may run into startling figures if a careful check is not maintained on their use. This requires an adequate metering equipment and a comprehensive system of records.

A good example of such a system is that used in the building previously mentioned, in which practically every service from the water and the oil that goes to the boilers, to the power supplied to each elevator machine, is metered. Figs. 1 to 7 show the records that are compiled from the meter readings. All of the integrating and recording meter readings are taken each day and the daily record forms, Figs. 1 to 6, made out. At the end of each month a monthly log, Fig. 7, is compiled. The daily records when made out are compared with the previous day and any unusual change in fuel, power or other quantities must be accounted for. In this way a continuous check is kept on the plant's operation.

The monthly log sheet is compared with that for the same month of the previous year and efforts made to account for any unusual change. In addition to the monthly log a composite monthly statement is made to the building management, giving the fuel used and on hand; pounds of steam produced and its distribution; water consumed and its distribution; gas consumed and its distribution. This report is made to show a comparison with the two previous months. At the first and middle of each year a statement is compiled showing the

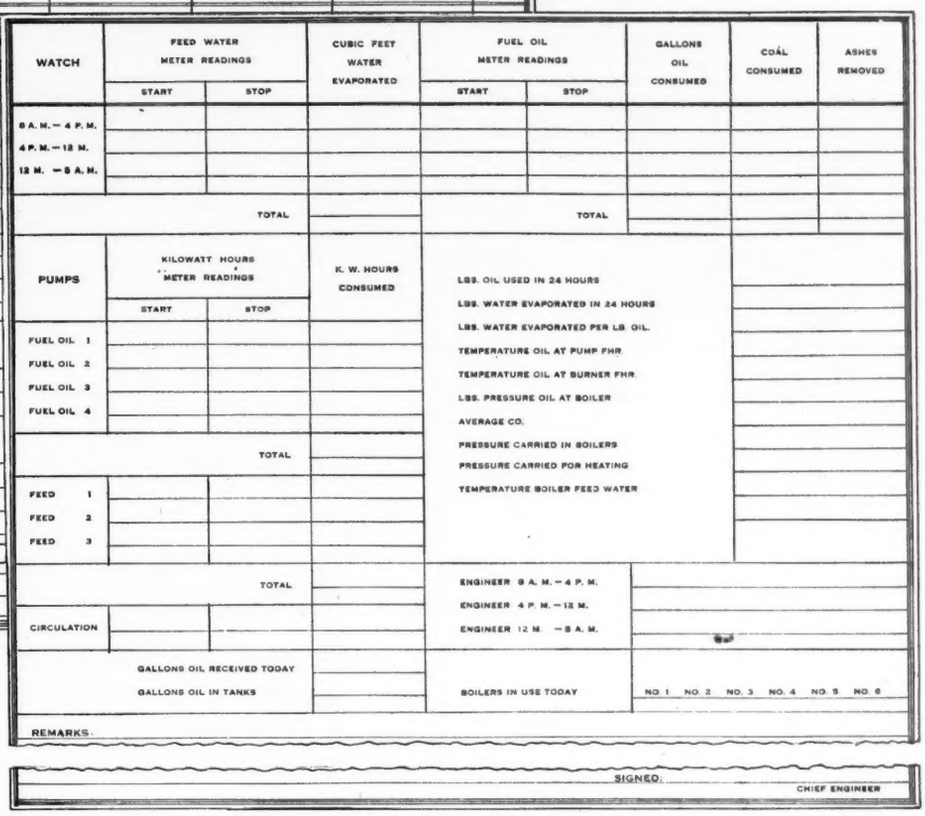


ELECTRIC, WATER AND GAS METER RECORD
THE EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING
393 SEVENTH AVENUE, NEW YORK, N. Y.
DATE _____ 19__

SERVICE		METER NUMBER	METER READINGS START	METER READINGS STOP	CONSUMED	TOTALS FOR DAY	REMARKS
ELECTRIC N. Y. EDISON	L						
	L						
	L						
	L						
	P						
	P						
WATER CITY OF N. Y.	31 ST.						
	32 ST.						
		1,049,447					
		1,049,448					
		1,049,449					
		1,049,450					
GAS NEW AMSTERDAM GAS CO.							
HOT WATER							
FILTER							

EXPLAIN REMARKS:

Fig. 1 (Left)—Daily report sheet of total electricity, water and gas purchased



WATCH	FEED WATER METER READINGS START	FEED WATER METER READINGS STOP	CUBIC FEET WATER EVAPORATED	FUEL OIL METER READINGS START	FUEL OIL METER READINGS STOP	GALLONS OIL CONSUMED	COAL CONSUMED	ASHES REMOVED
8 A. M. — 4 P. M.								
4 P. M. — 12 M.								
12 M. — 8 A. M.								
TOTAL					TOTAL			

PUMPS	KILOWATT HOURS METER READINGS START	KILOWATT HOURS METER READINGS STOP	K. W. HOURS CONSUMED
FUEL OIL 1			
FUEL OIL 2			
FUEL OIL 3			
FUEL OIL 4			
TOTAL			
FEED 1			
FEED 2			
FEED 3			
TOTAL			
CIRCULATION			

LBS. OIL USED IN 24 HOURS
LBS. WATER EVAPORATED IN 24 HOURS
LBS. WATER EVAPORATED PER LB. OIL
TEMPERATURE OIL AT PUMP FHR.
TEMPERATURE OIL AT BURNER FHR.
LBS. PRESSURE OIL AT BOILER
AVERAGE CO.
PRESSURE CARRIED IN BOILERS
PRESSURE CARRIED FOR HEATING
TEMPERATURE BOILER FEED WATER

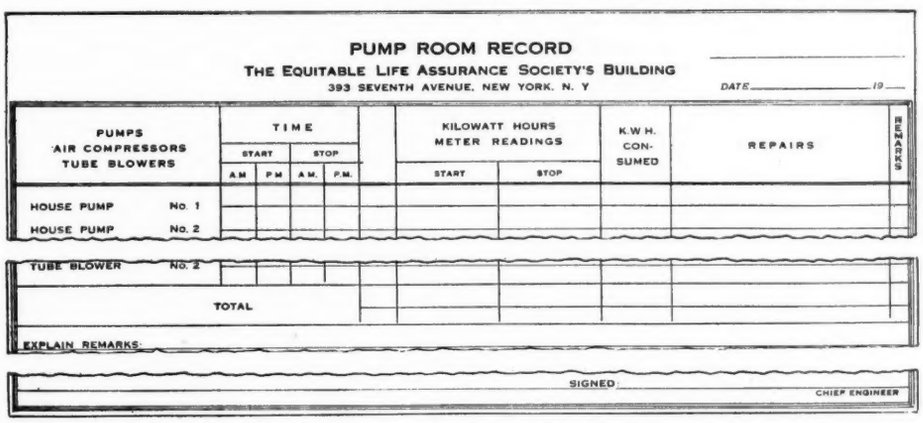
ENGINEER 8 A. M. — 4 P. M.
ENGINEER 4 P. M. — 12 M.
ENGINEER 12 M. — 8 A. M.

GALLONS OIL RECEIVED TODAY
GALLONS OIL IN TANKS
BOILERS IN USE TODAY — NO. 1 NO. 2 NO. 3 NO. 4 NO. 5 NO. 6

REMARKS:

SIGNED: _____ CHIEF ENGINEER

Fig. 2 (Right)—Daily report sheet for the boiler room



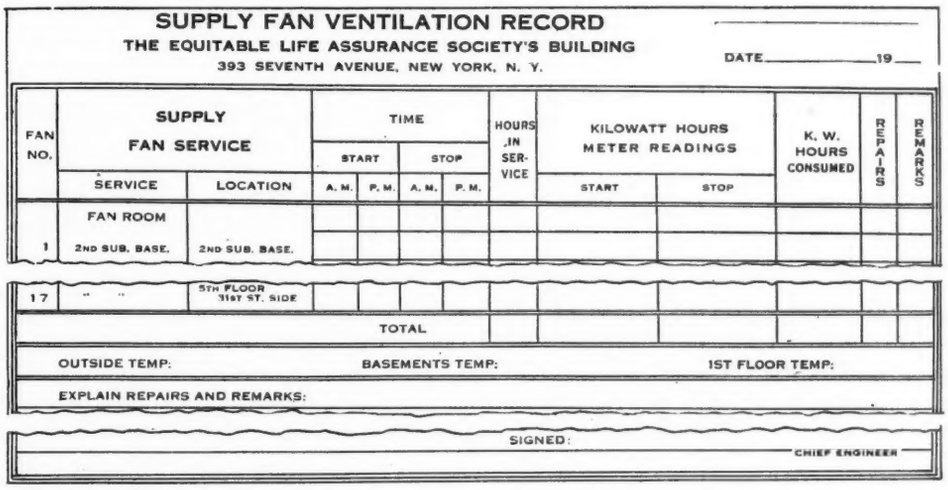
PUMP ROOM RECORD
THE EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING
393 SEVENTH AVENUE, NEW YORK, N. Y
DATE _____ 19__

PUMPS AIR COMPRESSORS TUBE BLOWERS	TIME START A.M.	TIME START P.M.	TIME STOP A.M.	TIME STOP P.M.	KILOWATT HOURS METER READINGS START	KILOWATT HOURS METER READINGS STOP	K.W.H. CONSUMED	REPAIRS	REMARKS
HOUSE PUMP No. 1									
HOUSE PUMP No. 2									
TUBE BLOWER No. 2									
TOTAL									

EXPLAIN REMARKS:

SIGNED: _____ CHIEF ENGINEER

Fig. 3 (Left)—Pump-room record sheet. A watt-hour meter is installed on the power feeder to each class of pumps



SUPPLY FAN VENTILATION RECORD
THE EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING
393 SEVENTH AVENUE, NEW YORK, N. Y.
DATE _____ 19__

FAN NO.	SUPPLY FAN SERVICE: SERVICE	SUPPLY FAN SERVICE: LOCATION	TIME START A. M.	TIME START P. M.	TIME STOP A. M.	TIME STOP P. M.	HOURS IN SERVICE	KILOWATT HOURS METER READINGS START	KILOWATT HOURS METER READINGS STOP	K. W. HOURS CONSUMED	REPAIRS	REMARKS
1	FAN ROOM 2ND SUB. BASE.	2ND SUB. BASE.										
17	" "	5TH FLOOR 31st ST. SIDE										
TOTAL												

OUTSIDE TEMP: BASEMENTS TEMP: 1ST FLOOR TEMP:

EXPLAIN REPAIRS AND REMARKS:

SIGNED: _____ CHIEF ENGINEER

Fig. 4 (Right)—Record sheet for the operation of the supply fans on the ventilating system. A similar report is made out for the exhaust fans

DAILY OPERATING REPORT

THE EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING

393 SEVENTH AVENUE, NEW YORK, N. Y.

DATE _____ 19__

APPARATUS	TIME START A.M.	TIME START P.M.	TIME STOP A.M.	TIME STOP P.M.	HRS. IN SERVICE	K. W. HRS. CONSUMED	REPAIRS	REMARKS
PUMPS & COMPRESSORS								
HOUSE PUMPS No. 1, 2, 3								
SPRINKLER PUMP No. 1								
FIRE PUMP No. 1								
VACUUM PUMPS No. 1, 2, 3								
SUMP PUMPS No. 1, 2, 3								
EJECTORS No. 1, 2, 3								
AIR COMPRESSORS No. 1, 2								
BLOW OFF PUMP No. 1								
TOTAL								
BOILER PLANT PUMPS								
FUEL OIL PUMPS No. 1, 2, 3, 4								
FEED PUMPS No. 1, 2, 3								
TOTAL								
FAN VENTILATION								
SUPPLY FANS								
EXHAUST FANS								
TOTAL								
PNEUMATIC TUBE BLOWERS								
TUBE BLOWER No. 1								
TUBE BLOWER No. 2								
TOTAL								

ELEVATORS	TIME START A.M.	TIME START P.M.	TIME STOP A.M.	TIME STOP P.M.	HRS. IN SERVICE	CAR MILES	K. W. HRS. CONSUMED	K. W. H. PER C. MI.	TRIPS PER CAR	REPAIRS	REMARKS
PASSENGER SERVICE											
GROUP D-2											
GROUP D-1											
GROUP C											
GROUP B											
GROUP A											
TOTAL FOR PASSENGER											
SPECIAL SERVICE											
FREIGHT No. 33											
LOW RISE No. 34											
SPECIAL PASS'R No. 35											
VAN LIFTS No. 36, 37											
TOTAL FOR SPECIALS											
TOTAL FOR ALL ELEVATORS											

BOILERS IN OPERATION

No. 1 No. 2 No. 3 No. 4 No. 5 No. 6

CU. FT. WATER EVAPORATED

RATE OF EVAPORATION

HEAT ON BUILDING (HRS.)

H. P. STEAM GENERATED

L. P. STEAM GENERATED

TOTAL LBS. STEAM

GALS. OIL CONSUMED

TONS COAL CONSUMED

GALS. OIL IN TANKS

TONS COAL IN BINS

LOADS OF ASHES

WATER SERVICE

CU. FT. WATER CONSUMED

GAS SERVICE

CU. FT. GAS CONSUMED

ELECTRIC SERVICE

K. W. H. TENANTS

K. W. H. EQUITABLE SOC.

K. W. H. BUILDING

TOTAL K. W. H. (LIGHT)

TOTAL K. W. H. (POWER)

TOTAL K. W. H. CONSUMED

TOTAL LABOR COST

IS ANY EQUIPMENT LAID UP FOR REPAIRS?

WHY? _____

WHEN WILL SAME BE READY FOR USE? _____

EXPLAIN REMARKS: _____

SIGNED: _____ CHIEF ENGINEER

Fig. 5 (Right)—Daily operating report. This is a consolidated report compiled from the daily record sheets made out for the boiler plant, the ventilating system, the pumps and compressors and the elevators. A margin is provided on all record sheets so that they can be conveniently bound in binders

ELEVATOR RECORD
HIGH RISE

THE EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING

393 SEVENTH AVENUE, NEW YORK, N. Y.

DATE _____ 19__

ELEVATOR SERVICE	ELEVATOR No.	TRAVEL	STOPS	HOURS IN SERVICE	CAR MILES METER READINGS START	CAR MILES METER READINGS STOP	MILES PER CAR	KILOWATT HOURS METER READINGS START	KILOWATT HOURS METER READINGS STOP	K. W. H. PER CAR	K. W. H. PER CAR MI.	TRIPS PER CAR	CAR STOPS TOTAL	CAR STOPS PER MILE	CAR STOPS PER TRIP
PASS'R	1	368'–4"	25B. TO 22												
"	2	368'–4"	25B. TO 22												
"	3	368'–4"	25B. TO 22												
						TOTAL									
						AVERAGE									
						AVERAGE									

CONDITION OF CABLES:

		VARIABLE VOLTAGE TYPE	RHEOSTATIC TYPE
	K. W. H.		
TOTAL	MILES: AVERAGE K. W. PER CAR MILE		
	TRIPS: AVERAGE MILES PER CAR		

SIGNED: _____ CHIEF ENGINEER

Fig. 6 (Left)—Daily record sheet for the high-rise elevators. A similar report is also made out for the low-rise elevators

MONTHLY OPERATING REPORT

THE EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING

393 SEVENTH AVENUE, NEW YORK, N. Y.

DATE _____ 19__

DATE	ELEVATOR CAR MILES	ELEVATOR K. W. HRS.	K. W. HRS. PER CAR MILE	K. W. HRS. EXHAUST FANS	K. W. HRS. SUPPLY FANS	K. W. HRS. PNEUMATIC TUBES	K. W. HRS. PUMPS COMPRESSOR	LBS. STEAM GENERATED	GALLONS FUEL OIL	TONS COAL	LOADS OF ASHES	CU. FT. GAS	CU. FT. WATER	K. W. HRS. POWER	K. W. HRS. LIGHT	REPAIRS	REMARKS
1																	
2																	
3																	
4																	
5																	
31																	
TOTAL																	

EXPLAIN REPAIRS _____

EXPLAIN REMARKS _____

SIGNED _____ CHIEF ENGINEER

Fig. 7 (Right)—Each month a report is compiled that gives a daily comparison of the plant's operation

LIST OF METERS INSTALLED IN EQUITABLE LIFE ASSURANCE SOCIETY'S BUILDING

Service	Number Units	Type of Meter	Number of Meters
Light and power service from street	..	Watt-hour	6
		Recording watt meters	2
		Ammeters	4
		Voltmeter	1
Water service from street	..	Water	2
Gas from street	..	Gas	1
Tenants' gas	..	Gas	2
Boilers	6	Steam-pressure gages	6
		Draft gages	4
		Feed-water venturi	1
		Feed-water recording thermometer	1
		Feed-water make up	1
		Stack temperature recorders	3
		Smoke-density indicator	1
		CO_2 recorders	5
		CO_2 analyzer	1
		Oil-pressure gages	5
		Oil-temperature recorder	1
		Oil thermometers	4
		Oil-volume meter	1
		Pneumercators on oil tanks	2
Feed-water pumps	3	Watt-hour	1
Building hot-water service	..	Steam flow	2
		Pressure gages	2
		Water meters	2
		Indicating thermometers	2
Building heating system	..	Steam flow	5
		Pressure gages	5
		Recording thermometers	3
Restaurant	..	Steam flow	1
		Pressure gage	1
House pumps	3	Watt-hour	1
		Altitude gages	3
		Pressure gages	1
Surge tanks	2	Pressure gages	2
Sprinkler and fire-pumps	2	Watt-hour	1
		Voltmeter	2
		Ammeter	2
		Pressure gages	6
		Altitude gage	1
Vacuum pumps	3	Watt-hour	1
		Vacuum gages	1
Sump pumps	3	Watt-hour	1
Pneumatic-tube blowers	2	Watt-hour	2
		Mercury columns	2
Air compressors	2	Watt-hour	1
		Pressure gages	5
Ventilation supply fans	17	Watt-hour	17
		Recording thermometers	17
Air washers	17	Indicating thermometers	17
		Pressure gages on nozzles	51
		Pressure gages on pumps	34
		Make-up water meters	4
Ventilation exhaust fans	29	Watt-hour	29
Passenger elevators	24	Watt-hour	24
		Mileage recorders	24
		Stop counters	24
Freight elevators	1	Watt-hour meters	1
		Mileage recorders	1
		Stop counters	1
Special elevators	2	Watt-hour	2
		Mileage recorders	2
		Stop counters	2
Storage batteries on signals	2	Ammeters	6
		Voltmeters	5
Water filter	1	Water	1
		Pressure gages	2
Tenants' power service	80	Watt-hour	80
Portable meters	..	Voltmeter	1
		Ammeter	1
		Volt-ammeter	1
		Wattmeters	2
		Insulation-resistance meter	1
		Magneto	1
		Tachometer	1
		Recording thermometers	6

plant's operation on a six months' basis. A yearly statement is made on the cost of fuel oil as compared to burning coal. In addition to these reports the management maintains a complete system of records that shows the cost of every service in the building.

In the boiler room, in addition to measuring the quantities of fuel oil and feed water that is supplied to the boilers, the steam supplied to the building services is metered. On the hot-water services there are two steam-flow meters, on the heating system there are five steam-flow meters and on the restaurant one steam-flow meter. These allow charging each service with its proper proportion of the cost for steam service, and to trace to its source any unusual increase in steam consumption.

In the distribution of electric power practically every use is metered. As indicated in the table, the house pumps, fire pumps, vacuum pumps, sump pumps, pneumatic-tube blower, air compressors, and each ventilating fan and elevator have watt-hour meters. These meters are read daily and a report compiled of the power consumption. The man who has charge of the ventilating fans reads the meters when he starts the fans in the morning and records these readings in a book that is returned to the chief engineer's office. From this book the record clerk makes out the report.

On each supply fan is a water-spray-type air washer. The power consumed by the pump motors on these washers is metered with that used by the fan motor. The make-up water to these washers is also metered. A daily comparison of the power and make-up-water records gives a check on the condition of the washers and other factors that influence their operation. Furthermore, if a fan is left running when it should not be, the watt meter will show this.

From these meter readings, sources of what would have developed into larger power losses have been located when they first appeared. On the pneumatic-tube blower it was noticed that there was a large increase in the power consumption. A check of all outside conditions showed nothing that could account for this change. The blower was opened up and it was found the rotor had started to rub on the casing, which was rectified at small expense. If it were not that careful records had been kept of the power consumption, the condition might not have been detected for a long time. During this period a large loss due to increased power consumption would have occurred and the blower would probably have been worn to such an extent that repairs would have been expensive.

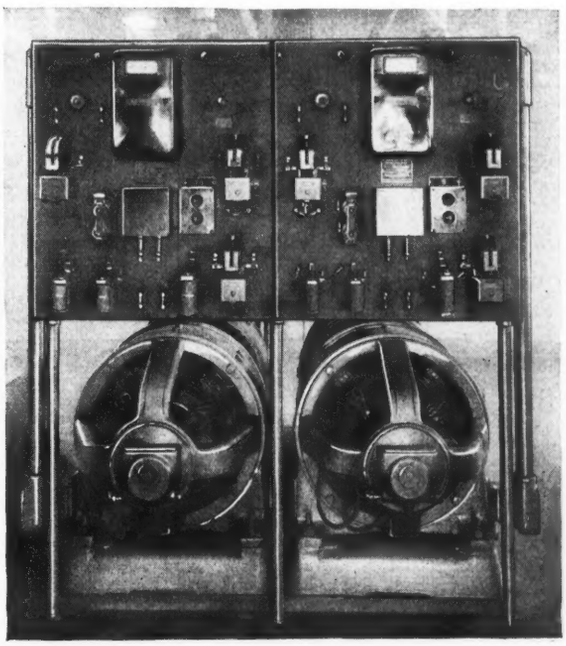


Fig. 8—A watt-hour meter is used on each elevator and is read daily

On another occasion the screens on the intakes to the blowers were stopped up with dirt during an unusually dirty period outside the building. This condition was detected as soon as it developed by the watt-hour meter readings and was immediately corrected. Many other instances can be cited of faulty operating conditions being shown by the watt-hour meters that probably would not

have been found for a long time if the meters had not been in daily use.

On the elevators in addition to the watt-hour meter on each machine there is a mileage recorder and a stop counter. Each day the meters and recorder are read and a report made out as shown in Fig. 6. This report tells a complete story of how the elevators have been operated. The stop counter is connected to the brake relay, so that every time the brake lifts it counts a stop. This gives a check on how the operator handles the car. When the number of stops per car-mile is consistently above the average it shows that unnecessary false stops are being made. If the number of stops per car-mile is consistently low it indicates that the operator is probably loafing and is not answering all the calls on his trips. The records show consistently an increase in power per car-mile when there are increases in the number of stops. It is evident that a good operator not only gives better service to the passengers but he does it with less wear on the equipment and at a lower power cost than does a poor operator. The cost of elevator operation in this building is one of the lowest in this country, which is the best answer to the question, Does it pay to keep such complete records?

The foregoing is also true of the other services. The meters give a check on the attendants' and machines' operation that could not be obtained otherwise. The meters are also very helpful to the operators in their work. They become familiar with the readings that mean good operation; any variation from these is a warning that something may be wrong and it is time to investigate.

The meters in this building have proved to be valuable watchdogs, always on the alert for conditions that cause power losses and expensive shutdowns. They not only show faulty operation, but they place the responsibility where it belongs. They make possible high efficiency in operation and give the operators a sense of pride and confidence in their work that they could not enjoy without an intimate knowledge of how the equipment in their charge is functioning. To sum up, their presence and the complete set of records that is maintained are an indication of good management.

The author expresses his appreciation for the opportunity to prepare this article given by E. G. Serle, chief engineer and superintendent of the Equitable Life Assurance Society's Building.

Why It Does Not *Pay* to Return *Boiler Blowoff* to the *Feed-Water* Softener

By J. D. Yoder
Cochrane Corporation, Philadelphia, Pa.

IT IS sometimes asked why the heat of the blowoff cannot be recovered in a simple and satisfactory manner by continuously discharging the blowoff into the sedimentation tank of the feed-water softener, thus conserving the heat as well as whatever chemicals there may be in the boiler water. Quite a number of the manufacturers of cold-process softeners in Europe have adopted this method of blowing down boilers, with improved results, but the improvements can be shown to be due largely to the increase in temperature of the water during the softening process.

The belief is held by some that calcium and magnesium carbonates are precipitated from the water completely, or as completely as is necessary, by heat alone, and that only as much sodium carbonate need be added as is necessary to combine with the sulphates of calcium and magnesium and to permit a desirable concentration of sodium carbonate in the boiler. This excess sodium carbonate can then be recovered by returning the blowoff water to the sedimentation tank.

The idea of returning boiler blowoff water to the sedimentation tank is by no means new, and is not covered by any valid patent, although there may be certain patents as to the method of controlling the blowdown water or other details of systems. The method has been known and discussed in Europe for more than 30 years. In 1897 M. A. Rossel, professor at the University of Berne, presented a paper before the Second International Congress of Applied Chemistry in Paris in which he completely described the process. In the conclusion of his report he stated that "the process is not patented and is therefore open to all." Accordingly, the reason why I do not advocate returning blowdown water to the softener is not because of patents, but because to do so is not, in my opinion, good practice.

In the softening of water a certain excess of sodium carbonate is necessary, and this sodium carbonate concentrates in the boiler. It is a simple matter to determine, for any particular water supply, approximately what will be the nature of the concentrates in the boiler and therefore the possible value of recovering these concentrates.

First, consider a high-carbonate, low-sulphate water of the analysis marked "raw" in the parallel columns below, wherein are given the approximate analysis after treatment in a hot process water softener and also an approximation of the analysis of the concentrated boiler water,

GRAINS PER UNITED STATES GALLON

	Raw	Treated	Boiler
Calcium carbonate	10.5	1.0	2.0
Magnesium carbonate	2.7	.5	.2
Silica	.6	.6	3.0
Iron and aluminum	.3	.3	.2
Sodium sulphate	.8	3.2	49.0
Sodium chloride	2.9	2.9	44.2
Sodium carbonate	1.6	1.6	4.9
Sodium hydrate in terms of $NaCO_3$	....	....	19.6
Volatile and organic	5.6	3.0	22.9
Suspended matter	....	....	54.2
Total solids	25.0	13.1	200.2

assuming that a total concentration of sodium salts plus suspended matter of 200 grains per gallon is permissible. This is furthermore based upon a boiler pressure of 200 lb. per sq.in., which requires a ratio of sodium sulphate to sodium carbonate of 2 to 1.

This water will require for treatment approximately 14.7 grains per gal., or 2.1 lb. per 1,000 gal., of 90 per cent calcium hydrate and 2.4 grains per gal., or 0.34 lb. per 1,000 gal., of sodium sulphate, the amount of lime being computed on the basis of sodium carbonate present as sodium bicarbonate which is to be expected in natural water supplies. If a total of the solids in the boiler water, including suspended matter, volatile and organic

matter, of 200 grains per gal. may be allowed, and if the total solids in the treated water are 13.1 grains per gal., the water will be concentrated in the boiler approximately 15.2 times. The quantities of each of the mineral solids, as well as of volatile and organic matter, will be increased in the boiler proportionately. The major portion of the calcium carbonate, magnesium carbonate, silica, iron oxide and alumina will be thrown out of solution to form suspended matter, leaving the water with relatively little of these solids in solution.

There is uncertainty as to the behavior of volatile and organic matter, so that for this comparison we have assumed that half of the organic matter would come down as a precipitate and the other half would remain in solution. Strictly speaking, some of this may volatilize, but in any event the boiler water will be considerably higher in organic matter than the original boiler feed. There is also considerable question as to the extent to which silica will be thrown out of solution, differing greatly with different water supplies. The analysis of the boiler water given is, however, sufficiently accurate for the present requirements.

The question now is, how much would all of the chemicals in the concentrated boiler water be worth for purposes of water softening, assuming that it might be possible to recover all of the blowoff water?

One hundred thousand gallons of this water requires for treatment 210 lb. of lime and 34 lb. of sodium sulphate, without utilizing any boiler blowoff water From examination of the solids present in the blowoff water, obviously the only chemical that might be of value is the sodium sulphate and that amount of sodium carbonate which is converted to sodium hydrate. These solids, unfortunately, are mixed with considerable amounts of impurities.

In that the suspended solids as well as the calcium and magnesium carbonates may be settled out in the water softener, they may be disregarded in a determination of the impurities. We then have a residue of mineral and organic solids as follows:

	Parts	Percentages
Silica	3.0	2.1
Sodium sulphate	49.0	34.0
Sodium chloride	44.2	30.8
Sodium carbonate	4.9	3.4
Sodium hydrate	19.6	13.8
Volatile and organic	22.9	15.9
		100.0

The question now is, how much could be paid for sodium sulphate or sodium hydrate mixed with such a large amount of impurities as is represented by the above analysis? The sodium sulphate on first consideration would seem to be the most valuable, but as this is mixed with one-half its amount of sodium carbonate, the value of the sodium sulphate is nil. The only purpose in feeding sodium sulphate is to increase the sodium-sulphate-to-sodium-carbonate ratio to 2 to 1. It is therefore plain to be seen that the sodium carbonate neutralizes any possible value to be derived from the sodium sulphate. Therefore, the only remaining chemical of value is the sodium hydrate, in that its hydrate radical will diminish the amount of lime required.

The value of this is easily computed on the assumption that approximately 80 per cent of the 1.6 grains sodium carbonate in the treated water is transposed to sodium hydrate, which will give an amount of 1.3 grains in terms of sodium carbonate. This is equivalent to 1 grain per gal. of 90 per cent calcium hydrate. Therefore, if all of the boiler blowoff could be returned to the softener, the amount of lime required would be only 13.7 grains per gal. instead of the 14.7 grains required without any blow-down water. This would represent a saving of only 6.8 per cent of the lime, or a little over 14 lb. for 100,000 gal. of water. To make this saving would involve adding as impurities sodium sulphate, sodium chloride, sodium carbonate, organic matter and silica, which would interfere with operation to an extent out of all proportion to the small savings to be realized.

That is a picture of the possible savings with what may be regarded as extreme of boiler water composition, that is, a water high in carbonates and low in sulphates. Let us now consider another water analysis, which does not represent an extreme, but nevertheless not a low sulphate water. The analysis follows:

GRAINS PER UNITED STATES GALLON

	Raw	Treated	Boiler
Calcium carbonate	10.8	1.0	2.0
Calcium sulphate	4.1	....	....
Magnesium carbonate	4.4	.5	.2
Silica	.6	.6	3.0
Iron oxide	.4	.3	.2
Sodium sulphate	4.2	8.5	110.5
Sodium chloride	1.2	1.2	15.6
Sodium carbonate	....	1.5	3.9
Sodium hydrate as $NaCO_3$	....	....	15.6
Volatile and organic	2.2	2.0	13.0
Suspended matter	....	....	39.0
Total solids	27.9	15.6	203.0

Again disregarding the calcium and magnesium carbonates, suspended matter, iron oxide and alumina, we have the following constituents:

	Parts	Percentage
Silica	3.0	1.8
Sodium sulphate	110.5	68.5
Sodium chloride	15.6	9.6
Sodium carbonate	19.5	12.1
Volatile and organic	13.0	8.0

In this case clearly the only constituent of the blowoff of possible value is the sodium carbonate. The question again comes up, how much is sodium carbonate containing approximately 88 per cent of impurities worth, these impurities being sodium sulphate, sodium chloride, organic matter, silica, in the above proportions? The plain fact is that no one would give consideration to the use of sodium carbonate of this purity for treatment of boiler feed water, even if it were given free of charge. In this case the water would require approximately 4.7 grains per gal. of sodium carbonate, of which 3.2 grains per gal. are used up by reaction with calcium sulphate and only 1½ grains per gal., or less than one-third of the amount fed, concentrates in the boiler. This one-third of sodium carbonate otherwise required would represent the maximum saving that might be made in the soda ash, but if soda ash of 88 per cent impurity were used it would increase the amount of blowing down required to such an extent as to make its use entirely impractical.

It is, of course, desirable to save the heat in boiler blowoff, providing this represents sufficient loss of heat to make the installation of blowoff equipment worth while. The type of equipment to be used should be such as will permit the recovery of the heat without the need of returning the filth to the boiler. This is easily accomplished by heat-exchange equipment. The delivery of the boiler blowoff directly into the softener, as in the older system, displaces a certain amount of exhaust or bled steam, and therefore loses the work which the exhaust or bled steam would have done by expansion in the turbine.

A question may arise as to why, if the return of the boiler blow-down water is of so little value, any installations should be made. It should be remembered, however, that in Europe ways and means of utilizing exhaust steam such as we have in this country have not been developed.

New Design Features in
OIL CIRCUIT BREAKERS

By A. W. Hill
Circuit-Breaker Engineer
Westinghouse Electric & Manufacturing Company

Substituting Welded Structures *for castings, using improved materials in the contact lifting rods and aluminum alloy in the contacts have contributed to improved oil circuit breaker performance.*

OIL CIRCUIT BREAKERS are called upon to function as the last means to remove trouble from a power system. In this service they are subjected to occasional heavy stresses, which require ample reserve interrupting capacity over the demands of ordinary switching service. With new materials now available, combined with modern design practices and operating experience, the modern oil circuit breaker for high-voltage service incorporates a number of new features, some of which are described as they apply to one standard make of apparatus.

Outwardly, one of the most apparent changes in design is the extensive use of fabricated steel, iron and steel castings being almost entirely eliminated. Apart from the element of production cost, the use of steel plate and structural shapes gives greater strength and also the product is more easily made oil- and weather-tight. Each round tank is given a hydraulic pressure test of 150 lb. per sq.in. to make sure that it is mechanically sound and oil-tight.

The substitution of welded construction for castings is also applied to the levers inside the pole mechanism. Here it makes possible a neater, simpler lever system, and also one of lighter weight. This is of particular importance, since power system interconnections and loads have increased to the point of making system stability a matter of great concern. Speed in operation is necessary, both in the closing stroke for convenience in synchronizing and in the opening stroke for protection against instability, and it is obtained more easily with the lighter moving parts. Friction is reduced in the lever system by using non-corrosive pins and washers, and, where the bearing loads are high, by the use of heat-treated and polished chrome-nickel steel shafts carried in bushings made of special bearing bronze.

Along with the question of speed, there is associated the necessity for stopping the moving parts when they reach the end of their travel without such undue rebound as would be obtained with the ordinary solid bumper stop. An oil dashpot is applied to each pole lever system, and is so located under the oil level as to take advantage of the oil always present when the breaker is in normal operation. Oscillographic records showing the travel of the contacts of the oil circuit breaker in its normal operating condition demonstrate that the rebound is limited to not more than 3 per cent of the

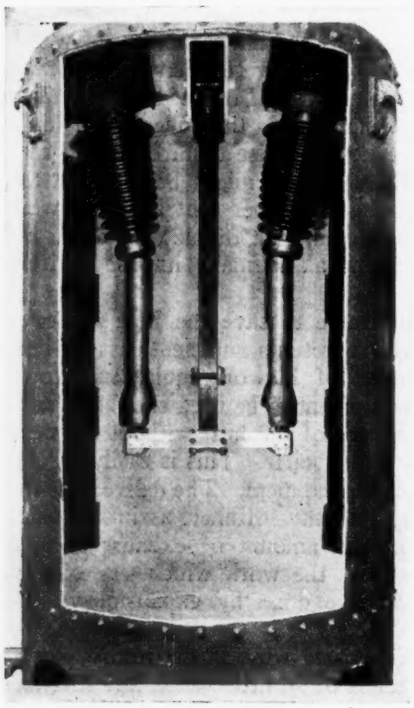


Fig. 1—Circuit breaker contacts in the closed position

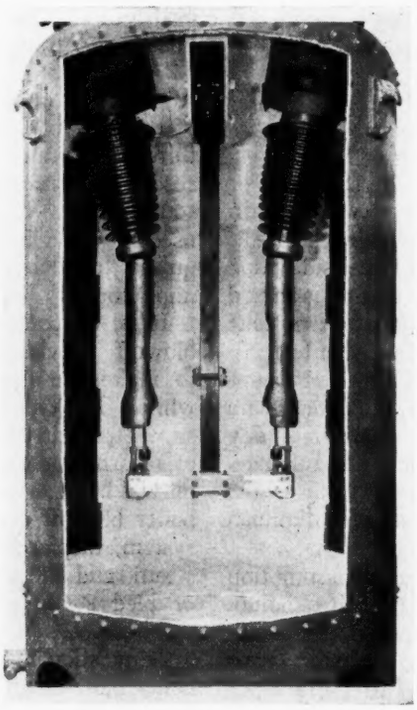


Fig. 2—Main contacts open, arcing contacts about to open

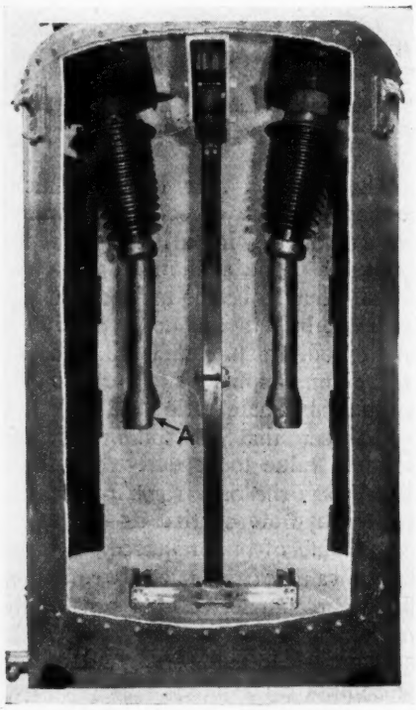


Fig. 3—Contacts dropped to the full-open position

total travel. This is so small as to be practically unnoticed in a visual examination of the breaker.

Another design feature directly associated with increasing sizes and higher operating speeds is the material to be used in the lifting rods which carry the moving contacts. Ordinary oil-treated wood, such as maple, ash or hickory, has never been all that was desired because of the possibility of running into cross grain, sometimes resulting in a broken rod. This possibility becomes more serious as the size of the apparatus increases.

New Material for Lift Rods

With breakers employing rods of 6-, 8- or even 10-ft. length, the use of ordinary wood is out of the question. Micarta tubes have been, and still are, used to a considerable extent in the smaller and moderate size breakers; but a new material, known as wood-base Micarta is now available. It is made from a number of pieces of wood veneer, impregnated with a synthetic resin, and molded under heat and pressure. The resulting product is uniformly strong mechanically, having no cross grain. Electrically it is one of the best commercial insulating materials known. It is quite easily machined and meets the requirements of the high-voltage oil circuit breaker. Oil or temperatures such as exist in normal circuit-breaker operation do not affect it, and this material does not warp or change its properties with age. It is available in such sizes that rods of one continuous piece can be used for even the largest breakers so far designed. The physical properties of wood Micarta are:

Tensile strength 22,000 lb. per square inch.

Compressive strength 23,500 lb. per square inch.

Modulus of elasticity (tension) 6,300,000 lb. per square inch.

In the high-voltage oil circuit breakers, wood base Micarta of rectangular cross-section is usually used, partly for convenience in machining and partly because of the ease with which a lifting-rod guide member can be designed.

Contacts are of the standard quick-break type, improved in details only. The stationary contact bell is cut away on the inner side at *A*, Fig. 3, so as to permit inspection of the interior parts more easily. A considerable amount of copper is put into the arcing tips to prevent their becoming burned away rapidly during arcing, and other parts are made as light as possible to insure fast operation. Thus the maintenance question is simplified in so far as the contacts of the circuit breaker are concerned.

The main contacts are of the butt type, made of copper, and have ample contact surface and pressure to handle the continuous current or momentary rating without trouble. The moving contacts are made lighter by the use of rolled aluminum-alloy (Duralumin) cross bars, with heat-treated aluminum-alloy castings mounting the contact at each end. The tensile strength of this aluminum alloy is around 50,000 to 55,000 lb. per sq.in., yield point 25,000 lb. per sq.in. (80 per cent that of steel), and its density only about one-third that of steel. It is evident that a considerable saving is made in energy required to operate the breaker and also the time required. At the same time no sacrifice is made in electrical considerations, since the electrical conductivity of the aluminum is approximately 50 per cent greater than that of brass.

Each design of these large high-voltage oil circuit breakers is given extensive performance tests at the factory, which determine, among other things, the speed of contact travel. It has been found that, in breakers having the features just described, the speed of contact travel is 30 to 50 per cent greater than of the older types and that less drain is made on the control battery. To the operating man this means that a fault will be cleared from the system in a shorter time than before and with less depreciation of dielectric strength of the oil in the breaker. It also means that a smaller control battery will be sufficient, and control leads to the circuit breakers, battery-charging equipment, etc., will be similarly affected.

The bushings are of the condenser type, made up of alternate layers of metal foil and insulation wound concentrically. The outer end of these bushings are protected from the weather by means of porcelain weather casings, which are made in a single piece for all except the very largest sizes. The condenser bushing has inherently a resiliency sufficient to withstand the shocks of severe breaker operations without failure.

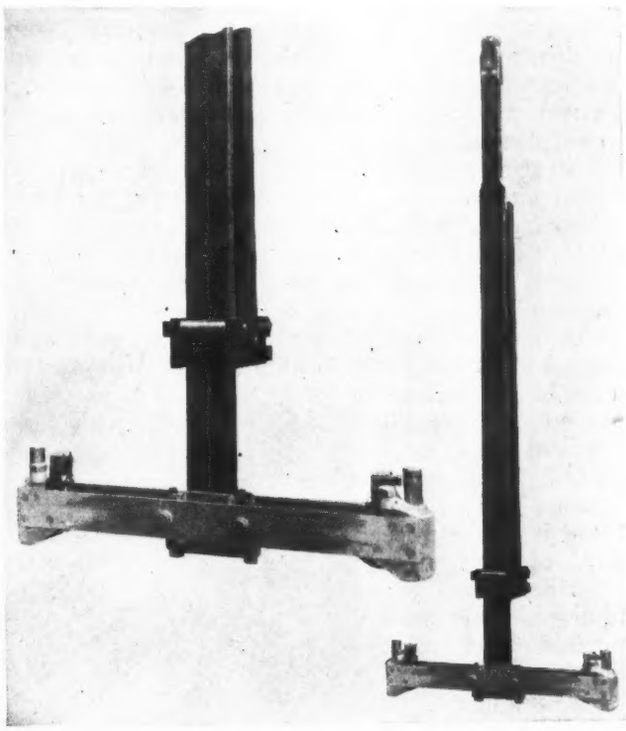


Fig. 4—Contact member of oil circuit breaker

On the right is shown the lift rod and contact member complete. On the left a larger view is given of the contact member and part of the lift rod. The contact structure is made of aluminum alloy to give it light weight combined with ample strength and good conductivity.

Each circuit breaker for 88,000 volts and above is equipped with facilities for obtaining voltage indications for synchronizing, relaying, load dispatching, or approximate metering. Each condenser bushing has a tap brought out from the outer layer of the condenser to a connector, which, when not in use, is suitably protected from the weather and accidental contact. Mounting pads are supplied on each tank, and a weather-proof housing containing the necessary equipment can quickly be attached. The device is simple of adjustment, with no parts that require frequent maintenance, and is inexpensive when compared with a potential transformer of other similar equipment. The insulation value of the bushing with the potential tap is in no way impaired for service conditions.

Power Costs Lowered by *Multiple-Effect* Compression

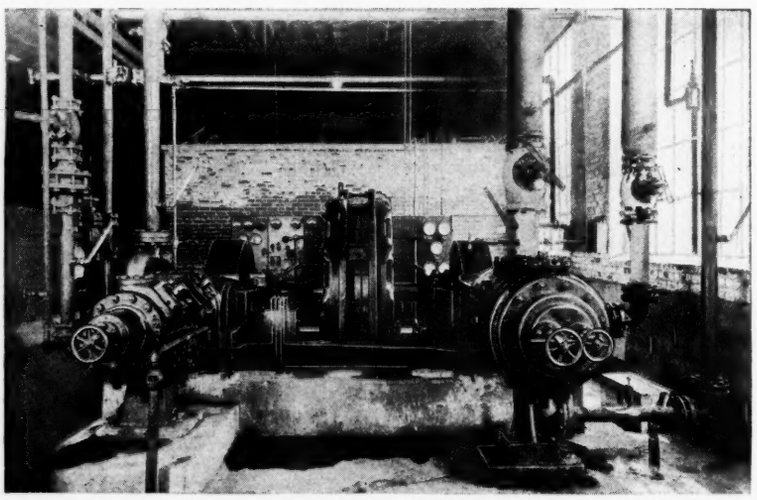
By F. P. MacNeil

THE efficient performance of the plant of the East Shore Ice Company, at New Dorp, Staten Island, New York City, could have been accomplished only with the aid of compound multiple-effect compression. It emphasizes again the advantage of this type of refrigerating plant and points the way to better economy to be obtained in other plants where the system can be applied.

The plant has produced first-quality ice at a power consumption of 39.6 kw.-hr. per ton, using condenser and can water at 70 deg. F.

The exceptionally low head pressure, 135 lb. gage, with 70 deg. condensing water, speaks volumes for compound compression with multiple effect.

The plant consists of one Worthington compound multiple-effect compressor, with 9 x 14-in. high-pressure and a 12 x 14-in. low-pressure cylinders, direct connected to a 200-hp. Ideal motor turning 225 r.p.m. There is but one ice tank, of the brine-cooler design and containing 1,050 three hundred-pound cans, and one air compressor, 8½ x 9 in., of 170 cu.ft. displacement, at 300 r.p.m., driven by a 20-hp. motor.



Layout of the plant

Two vertical shell-and-tube condensers and one intercooler of the same design for cooling the gas while it is passing from the low-pressure to the high-pressure cylinder are part of the equipment. Two shell-and-tube dehydrators placed horizontally one above the other and arranged to operate alternately remove the moisture from the air used for agitation. There are a shell-and-coil accumulator used as a multiple-effect receiver or liquid cooler, a quartz-sand filter and an ammonia purifyer. The diagrammatical layout of the engine room is shown in the drawing on the next page.

A log covering two weeks' performance shows that an abnormally small temperature difference was maintained between the liquid ammonia in the brine coolers and the brine. This indicates a good heat transfer. Another point is that there is a very uniform distribution of the brine in the ice tank, otherwise there would be a great amount of cracked ice when using so low a brine temperature.

The freezing time is 40.6 hr. Forecooling the can water from 70 to 34 deg. F. helps to preserve a uniform temperature in the brine, there being not over one degree difference between any two points of the tank. Cooling the liquid ammonia in the multiple-effect cooler relieves the brine coolers of the extra volume of vapor that would result if the cooling of the liquid were done there at a lower pressure. This also assures less violent ebullition, or evaporation, of the ammonia in the coolers, because there is not the disturbance there that high-temperature ammonia would cause upon entering the cooler. Naturally, the coolers can carry a higher liquid ammonia level without fear of priming and sending liquid to the compressor. This, in turn, means greater heat transfer.

Compound compression assists in lowering the power cost. The temperature of the high-pressure suction being 90 deg. F. and that of the low-pressure discharge being 130 deg., it can be seen that for every pound of ammonia circulated there are 24 B.t.u. taken out in the intercooler between stages, resulting in a compression reduction of over one-half a horsepower per pound of liquid circulated.

Doing the work in two stages splits the compression ratio, so that cylinder temperatures do not run so high as they would in one compression. This means that the cooler cylinders will take in more gas per stroke. If cold gas expands on meeting a hot cylinder and only a small portion of it enters, it is evident that it is going to take a longer time to pump a given weight of gas than if the cylinder were cooler. Of course the more gas the cylinder will take the more power will be required for compression, but more refrigeration will be done also and in addition the mechanical efficiency will be greater.

Forecooling the can water and precooling the liquid ammonia are gains, because they are done at high-pressure outside of the ice tank, and the volume of vapor resulting from these coolings is smaller than if

done at low pressure in the ice tank. Obviously, this system of refrigeration requires less cylinder capacity and less power. On top of this, if the vapor at high pressure can be made to do some work, it can be seen that the advantage gained in the first place is compounded.

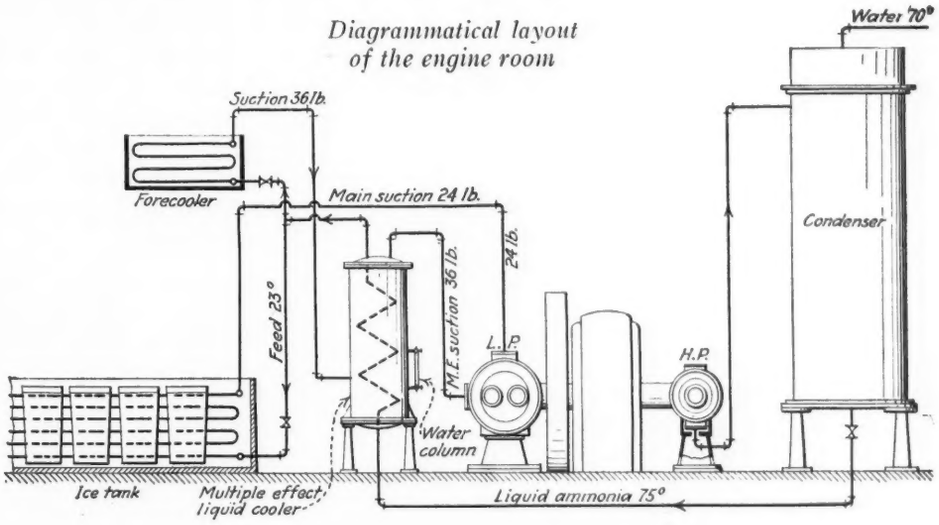
This is what happens using multiple effect. For each pound of ammonia vapor passing through the compressor from the low suction, the high suction does 15 B.t.u. of the total work to compress it. This amounts to no trifling figure when the whole compression requires 80 B.t.u. of work under the conditions prevailing when using compound compression; this 15 B.t.u. is power that the electric motor does not have to supply.

The plant was installed by the Carbondale New York Company and was designed to be operated by one man per shift.

Log of Plant Operation

Cakes pulled in 14 days	8,680
Cakes per day, average	620
Kw.-hr. consumed	51,660
Kw.-hr. per day	3,690
Tonnage pulled in 14 days	1,302
Tonnage per day	93
Kw.-hr. per ton	39.6
Head pressure, lb. gage	135
Temperature of discharge, deg. F.	184
Suction pressure, lb. gage	24
Temperature of suction, deg. F.	18
Intermediate pressure, lb. gage	60
Temperature of intermediate gas, deg. F.	130
High suction pressure, lb. gage	36
Temperature of m.-e. suction at compressor, deg. F.	29
Temperature of air for raw-water system, deg. F.	25
Temperature of brine, deg. F.	13
Temperature of can water, deg. F.	34
Temperature of store room, deg. F.	28

Diagrammatical layout of the engine room



The Application of Pulverized Coal to Steam Boilers*

By Henry Kreisinger
Combustion Engineering Corporation, New York City

THE first successful application of pulverized coal to steam boilers was made by Bettington about twenty years ago. He used a specially designed steam-generating unit in which the boiler was placed around the furnace. Thus he obtained a completely water-cooled furnace, which he considered necessary for the successful use of pulverized coal. In this unit the coal was fired vertically upward through a water-cooled burner located in the bottom of the furnace. In such installations the direct-firing system was used. Some units of this type are still giving satisfactory service in Canada.

His radical departure in design of steam-generating units was probably the main reason why Bettington's success did not cause a more general adoption of pulverized coal. What was needed at the time was a method of burning pulverized coal that could readily be applied to existing designs of boilers.

The next ten years saw little development in applying this type of firing to standard boilers. Attempts to use small refractory furnaces failed because of the slagging action of the molten ash.

Greatly reduced rates of combustion showed satisfactory results, but even when the walls were made hollow and cooled by drawing the air used for combustion through them, the rates were still limited to 1½ lb. of coal per cubic foot.

Water cooling was first introduced to cool the ash deposited at the bottom, and was then extended to protect the rear walls. Much more satisfactory results were obtained, and on the next installation side walls of furnaces were also water cooled. With the completely water-cooled furnace, the rate of combustion can be carried to 2½ and even 3 lb. of average steaming coal per cubic foot of combustion space per hour.

It has been amply demonstrated that all kinds of coal, ranging from anthracite to lignite, can be burned in pulverized form with good results. The lignites are particularly well adapted to this method of burning. They can be pulverized and burned with a moisture content as high as 28 per cent, so that comparatively little drying is necessary.

The degree of fineness to which a coal must be pulverized in order that it may be burned satisfactorily depends, in general, upon the percentage of fixed carbon. The volatile matter is distilled off and burns as gas when the coal is heated. The fixed carbon, on the other hand, stays in the coal particles as coke and must be burned while in suspension in the furnace. The higher the fixed carbon, the larger the particles of coke to be burned in suspension after the volatile matter has been distilled.

*Abstracted from "Powdered Coal in American Industry." Report of Market Research Institute, National Coal Association.

Proper Time Keeping Gives Accurate Basis for Costing

By Walter N. Polakov*
Consulting Engineer, New York City

EVERY concern has some established practice for keeping its employees' time. Power house work presents several specific problems which require different methods of handling; such as changes from regular to irregular work, time spent on inspection, in acceptance of watches, division between operating and maintenance work, etc. No accounting can be accurate and no executive can benefit fully by mere records of attendance unless these items are correctly separated.

The standard practice outlined in the following instructions on time keeping gives an accurate basis for payroll distribution and proper control of labor costs.

Time Keeping

Object: The purpose of time keeping is to know:
Who worked,
Where worked,
What was done,
What was paid for it.

Ringing cards "in" and "out" at the gate does not provide the information needed, as it fails to indicate:

1. When a man started work.
2. Whether he did other than regular work.
3. How to distribute the payroll.

Equipment: Power plant employees are provided with a special time card covering a one week's period on which following identifications are marked:

Department. Name. Badge Number. Occupation.

In cases of maintenance or miscellaneous work not specified on the weekly time card, special job time cards are used.

Responsibility: The chief engineer is responsible for the correct keeping of time of employees as well as of equipment. He delegates to the watch engineers the actual marking of time on the cards for employees reporting for work and leaving. In case of the tardiness or absence of a man, the chief engineer is responsible for proper entries on the card to avoid errors in the payroll.

Change of Jobs: Whenever an employee is temporarily assigned to work which is not his permanent occupation, for instance a fireman assigned to maintenance work, the person assigning him to such work marks on the job time card the time when "started," and again, upon completion of the job, "finished." The chief engineer is responsible for giving a proper charge symbol to such jobs on the cards. He also approves any overtime work, which is covered by a special "overtime" job time card.

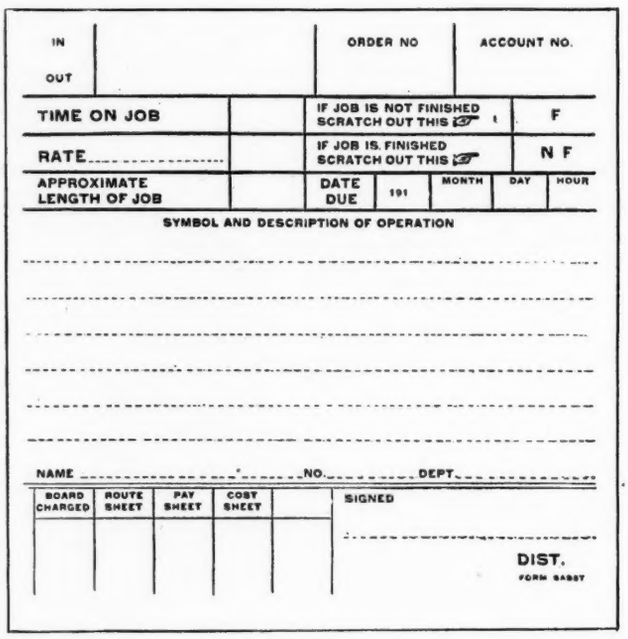
Working Hours: In order to avoid dangers to life and property, as well as to minimize the operating loss, the head firemen and watch engineers should work in three shifts of 8.3 hours, making their total payroll time 25 hours per day.

Employees are not relieved from the watch until 20 minutes after the new shift reports. This provides for attendance in case of accidental tardiness of the incoming shift and gives time for the outgoing shift to report the conditions of equipment, pass instructions, and for both shifts to check readings of instruments together; and allows the incoming shift to test safety valves, water guages, pumps, valves and other items as required by the boiler insurance.

Computing Cards: Time cards are computed once a week immediately after they are collected and before they are sent to the payroll clerk.

Operating time is separated from time spent on repairs, maintenance and administrations by means of charge symbols on the time cards. Then the total pay is properly distributed under these headings and the labor cost is entered on the repair record [see article by Walter N. Polakov in *Power*, Aug. 20, 1929]. Overtime work is computed separately under each symbol of classification.

Machine Shop Help: At the end of each week the chief operating engineer requests from the machine shop foreman the summary of labor charges (if any) on jobs done for the power development, bearing correct charge symbols or numbers. He checks them against the work order slips and then enters those



Sample of time card used for power plant work where task and bonus wage system is employed

charges on repair record cards against each job in the "labor" column, in addition to the labor charge of the power department's employees.

Outside Help: If outside help is engaged to do work in the power department, the men are treated as if they were company's employees, and the chief engineer or the watch engineer keeps their time for the purpose of:

1. Properly figuring the cost of the job.
2. Checking against the contractor's charges.

The same practice applies to yard men if assigned to the power department for more than one day. If their help was temporary for a period of less than one day, the same practice as described for machine shop men shall be followed.

Bonus: If any man has been working on the task with bonus system, the chief engineer, after ascertaining whether the bonus was earned or lost, makes on the margin, for that day, an entry indicating the amount of bonus earned. Men entitled to bonuses are given "bonus slips."

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Half a Million Gallons of Water Each Minute Will Flow to the FORD Rouge Plant

To Supply Condensing Water *for two new 110,000 kw. turbine-generators and additionl plant services, water will be drawn from the Detroit River, 2¼ miles away, through a gravity tunnel fifteen feet in diameter.*

WITH the continued growth of the Rouge River plant of the Ford Motor Company, and the increasing demand for power which followed, the problem of securing sufficient uncontaminated water at a temperature suitable for condenser cooling and general mill service became increasingly acute. An immediate enlargement of the power plant by nearly 100 per cent, with provisions for a similar increase when the demand warranted, forced the issue. It will become necessary to draw direct from the Detroit River an amount of water that may reach 500,000 gal. per min. when the tunnel is operating at full capacity.

Reference to the accompanying map will show the location of the Rouge plant, in Dearborn, and its position relative to the Detroit and Rouge Rivers. Originally the Rouge River was a small, sluggish stream with a flow during the summer months ranging from 50 to 200 sec.-ft., and an average temperature as high as 75 to 80 deg. F.

During the World War the portion of the stream between the plant and the Detroit River was dredged and widened, and the channel straightened for navigation purposes. At the plant there is a large turning basin and a long slip, 250 ft. wide. From the closed end of this slip water is drawn for power plant and mill use. About 325,000 gal. per min. is used for condensing purposes in the power house. In the plant are four 30,000-kw. and two 12,500-kw. condensing turbine-generators and three 40,000-c.f.m. blowers driven by turbines exhausting to surface condensers. The additional mill demand puts the total over 400,000 gallons per minute.

Water to the steel mill and glass plant areas, after being used for general cooling and slushing, is returned to the Upper Rouge River, warming the water of the stream above the plant to a temperature of about 85 deg. F. during the summer. The discharge water from the power plant enters the river at *C*.

The plant demand exceeds the flow of the stream by over four times, since about 900 sec.-ft. is drawn from the slip, while the average normal flow for the river and Roulo Creek is but 200 sec.-ft. This leaves about 700 sec.-ft. to be obtained by reversing the current in the river. In other words, from the outlet to the inlet, a comparatively short loop, *C A B C*, is created, in which the temperature during the summer months builds up, due to the recirculation, to an average of 90 deg., and has reached a maximum of 96 deg.

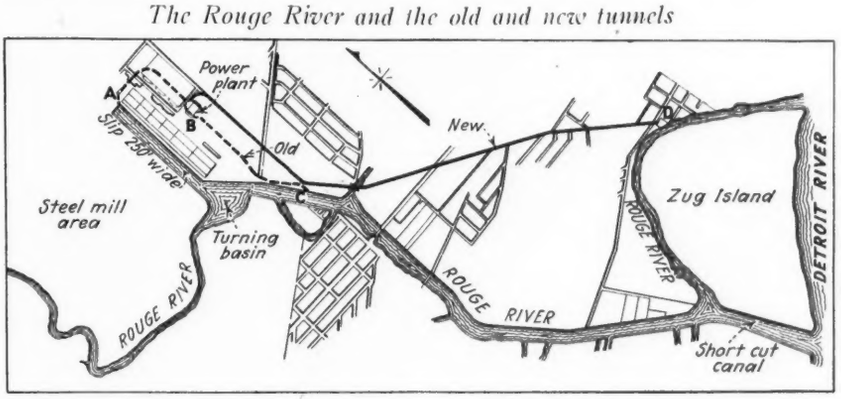
When expanding business conditions made it necessary to increase the capacity of the power plant it was planned to remove the two small generating units and install in the space available two 110,000-kw. turbine-generators. The first unit is now ordered and the second will be installed as determined by demand. Each of these machines will require about 150,000 gal. per min. of condenser cooling water, and the total normal demand will be about 450,000 gal. per min. Provision will be made to care for a peak load of 500,000 gal. per min., or 1,111 second-feet.

To relieve the unsatisfactory condition of the water supply, two proposals were considered. One was to draw the water from the upper Rouge, thereby increasing the distance from outlet to inlet and enlarging the cooling surface. It was decided that this plan would have meant recirculating much of the water as before, with little opportunity for the water to clear itself, and sufficient cooling would have involved spraying.

The other plan, which was adopted, was to build a gravity flow tunnel from the power house to the Detroit River. This tunnel will serve as the intake, and the water will be returned through the old tunnels to the slip and the Rouge River, thereby flushing the slip and clearing up the present turbid condition of the river water. This project will give water averaging 71 deg. for the two hottest months, about twenty degrees cooler than the present supply.

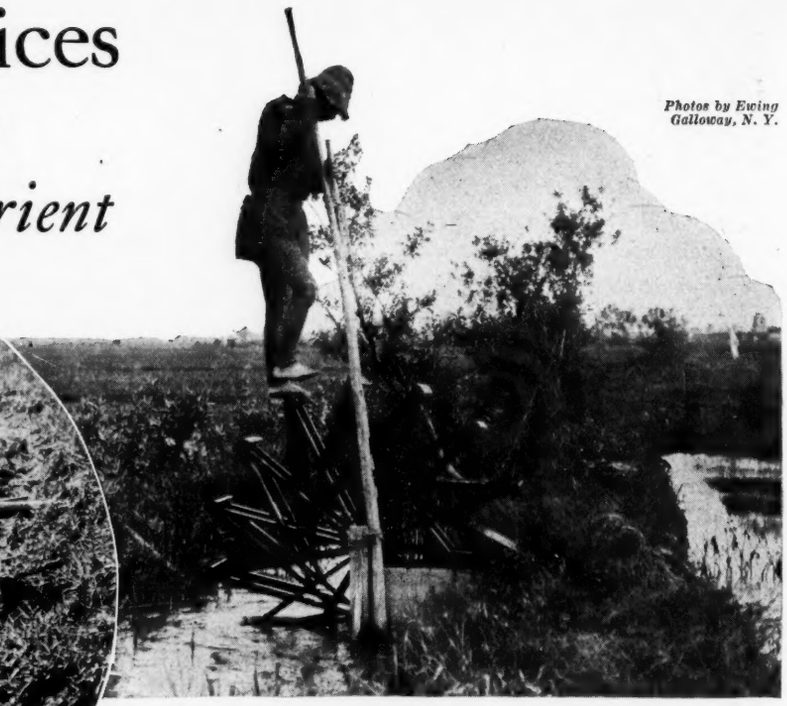
The tunnel, which is now being built, will extend from the point *D*, near the original mouth of the Rouge River, to a terminal forming the junction with the present power house and general service tunnels. The distance is 12,000 ft., and the inside diameter of the tunnel will be 15 ft. It will be constructed 40 ft. underground by the "shield" method and the concrete poured in place. The plan will be to simultaneously operate four headings. For the intake elaborate designs are being prepared to prevent the induction of currents that would tend to draw boats to the bank of the narrow stream, and the work at the terminal will also be of a complicated character. The completion of the work will make available an excellent supply of water sufficient for all requirements for years to come.

The Rouge River and the old and new tunnels



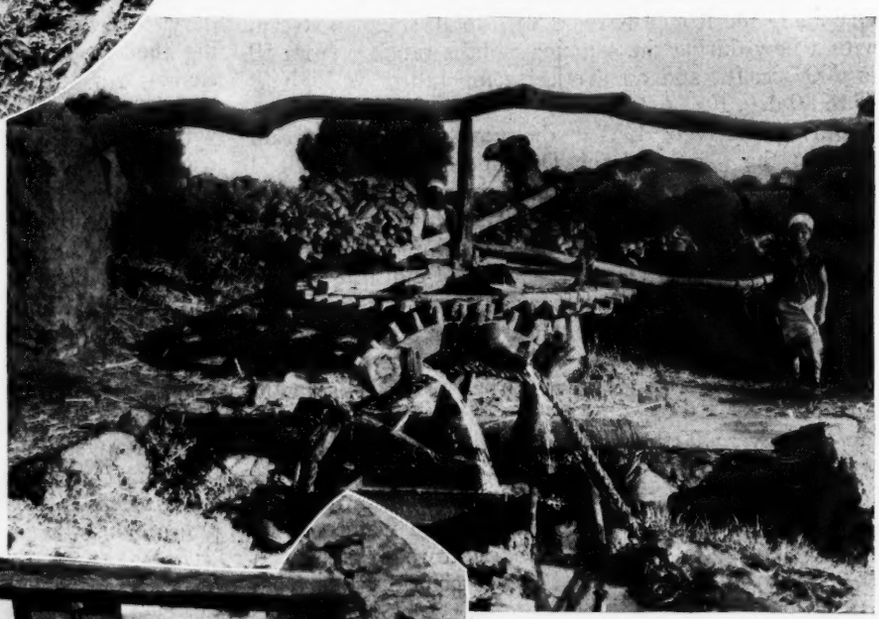
Power Services *In the Orient*

Photos by Ewing Galloway, N. Y.



Pumping (Above)—Japanese farmer irrigates his rice field by treading the paddle wheel

Alarm System (Above)—Water fills the upper compartment of the bamboo tube—the tube tilts, spills the water and falls on the rock with a sound like a bell—the wild hog is thereby frightened away from the Ceylon rice field



Mechanical Power Transmission and Pumping (Above)—Aside from the fact that a camel is made to pump water, this outfit, on the Nile, is at least consistent; the gear is as good as the pump

Mechanical Transmission (Left)—In spite of the amply large "roller bearing," this lower-Nile stone crusher demands three-sevenths horse power, reckoning seven men equal to one horse

Design Features of High-Pressure Feed Pumps in a German Plant

By R. W. Miller
Witten, Germany

THE power plant at Mannheim Rheiman, Germany, recently added to its present 285-lb. plant two 1,450-lb. boilers, each capable of evaporating 132,200 lb. of water per hour. High-pressure turbines exhausting at 285-lb. pressure to the low-pressure part of the plant increase the capacity of the station by 9,500 kilowatts.

Fig. 2 shows diagrammatically the layout of the feed-water system. The steam pressure falls from 1,450 to 285 lb. in the primary turbines and then passes through intermediate steam superheaters to the main condensing turbines. The condensate is withdrawn from the condenser by a two-stage condensate pump, which is combined in one pumping set with the cooling-water and air-ejector-water pumps. The condensate, together with the makeup, is delivered at a temperature of about 175 deg. to four intermediate pumps that deliver the water into a system of constant-pressure heat accumulators, where its temperature is raised almost to the boiling point. The four four-stage intermediate pumps each deliver 550 g.p.m. against a total head of 355 lb. and are driven by 180-hp. motors. From the heat accumulators the water flows at a temperature of about 392 deg. and under a pressure of 265 lb. to the nine-stage high-pressure feed pumps. Each of these pumps delivers normally 400 g.p.m. and increases the pressure by 1,325 lb., so that the pressure at the end of the ninth stage reaches 1,590 lb. At this pressure the water passes through economizers and into the boilers.

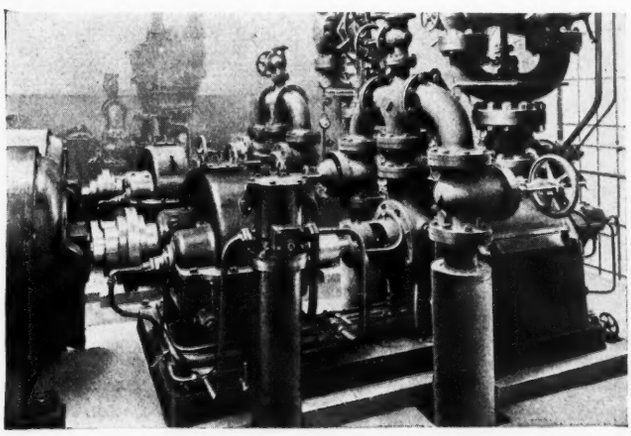


Fig. 1—Pump room at Mannheim, Germany, showing the new 1,590-lb. boiler feed pumps of 400-g.p.m. capacity

The exhaust steam from the primary turbines at a pressure of 285 lb. and at a temperature of 482 deg. enters the intermediate superheater, where its temperature is raised to about 645 deg. before entering the main turbines. For this purpose live steam at a pressure of 1,450 lb. is passed through the superheater, along the outside of the tubes carrying the 285-lb. steam. The condensate from the superheater at a temperature of between 570 and 580 deg. is introduced through an auxiliary branch into the high-pressure boiler-feed pump, which it enters at a pressure of 1,170-lb. gage. To reduce the fall in pressure to a minimum this branch enters the pump between the sixth and seventh stages.

When the feed pumps are delivering a small quantity of water, the very hot superheater condensate may cause the temperature in the last stages of the pumps and behind the balancing disks to rise considerably. If, for example, the quantity required by the boilers falls to 22,000 lb. per hour, and about 15,500 lb. per hour of condensate constantly enters the pumps after the sixth stage, the temperature of the resulting mixture will be about 455 deg., corresponding to a saturation pressure of 435 lb. But the back pressure on the balancing disk cannot exceed 260 lb. It is, therefore, necessary either to cool the water led to the balancing disk, entailing a loss of heat, or, and this is the more practical solution, lead it back to the steam space of the accumulator. In this way all useless complications are avoided.

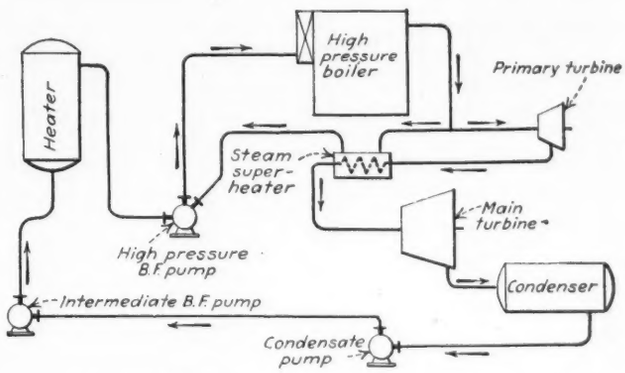


Fig. 2—Diagram showing feed-water system

Because of the decrease in power consumption obtainable by speed regulation as compared with regulation by throttling the delivery valve on the pumps, the electrically driven pumping sets are fitted with speed regulators. For this purpose the motors are designed as Scherbius machines, with frequency converters. It was not possible to couple the electric motors directly to the pumps, because of limited motor speeds, as they would then require too many stages for a single-casing pump. For this reason the pumps are driven through spur gearing with a speed ratio of 1,470 to 4,650.

In designing these pumps particular attention was paid to making proper allowance for heat stresses. As shown in Fig. 1, the pumps do not rest on feet, as is usual, but are suspended in the horizontal axial plane on lateral supports. This avoids any alteration in alignment due to vertical expansion. The casing of the pump is free to move axially in its supports as it expands or contracts. The material of which the shaft and moving parts are made was chosen to obtain the same coefficient of expansion as the bushings, they being particularly sensitive to compression stresses.

Where the shaft issues from the casing the leakage of water, which is at a temperature of 390 deg., must be prevented, as even a small leakage at this temperature would cause a large quantity of steam to be formed. The sealing water that enters the stuffing boxes must, therefore, be well cooled.

For this purpose either external or internal cooling can be employed, the latter method having been adopted

for these pumps, as illustrated in Fig. 3. In order to avoid losses of heat, the amount of cooling is restricted as much as possible. Only at the rubbing surfaces of the stuffing boxes is any attempt made to greatly reduce the temperature of any leakage water by outer and inner cooling. The cooling water passes through a passage

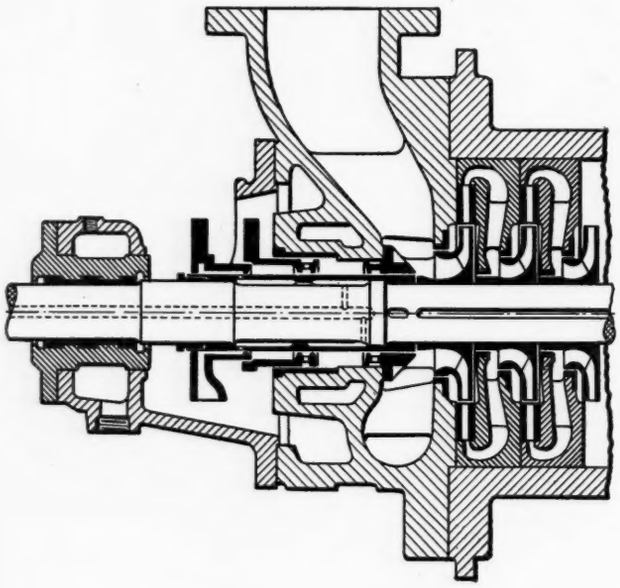


Fig. 3—Cross-section showing shaft seal of high-pressure feed pump

in the shaft and is injected into the cooling space that rotates with the shaft. The water then passes over the whole stuffing-box packing and leaves through an orifice in the stuffing-box gland.

In order to render the pumps thoroughly tight, a water seal is also used. The sealing water is taken at a temperature of 175 deg. and a pressure of 285 lb. from the intermediate pumps, and is introduced into the inner lantern, situated before the double stuffing box. Because of its high pressure it forms a relatively cold collar, so that the hot water in the suction space of the pump is shut off from the packing. The sealing water then flows over the outer lantern, situated between the two spaces of the stuffing box, and returns to the condensate collecting tank. The heat taken up by the sealing water is, therefore, not lost. Fig. 1 shows that this method for preventing leakage works efficiently, as no vapor escapes.

The pumps have now been in service for some time without giving the slightest trouble, but not long enough to allow of any definite service results being obtained.

ASSURING JACKET CLEARANCE—Among the many useful wrinkles that I learned from the late Mons. Arthur Bollinckx in Brussels was a method of making jacketed steam engine cylinders so that the space between the cylinder proper and the jacket was absolutely clear, and that there were no blowholes in either wall. The cylinder proper, front (crank-end), head and back flange were cast in one piece and bored and faced; the jacket and "out" head were cast in another piece, and counterbored. The two, if perfect, just pressed together hydraulically. Any blowholes in either were bored out and filled with accurately turned plugs, hydraulically pressed in, no threading of the plugs being necessary.—ROBERT GRIMSHAW.

Calcutta Has Difficult Smoke Problem

CONTINUED improvements in smoke abatement in the face of several difficulties peculiar to the region have been made by the Bengal Smoke Nuisances Commission in the city of Calcutta, India, according to a report of that body. Since 1906, when the commission was organized, the daily emission of black smoke from industrial plants and ships has been cut to 1/25 of its former volume.

When the commission assumed control the law provided only for prosecution after the smoke had been made. Since that time, however, the problem has been attacked from the other end. Advice and recommendations in regard to furnaces, flues, stacks, etc., have not only improved the smoke situation, but have also made it possible to replace prosecution with co-operation. There have been no prosecutions for the past three years.

The great problem in Calcutta today is not industrial smoke, but domestic smoke. There are no chimneys, and domestic smoke is discharged at ground level. During the cold weather months rain and wind are at a minimum, making the situation worse. At the present time some residential areas are far worse than the industrial section, and the death rate due to respiratory diseases is more than twice as great where the domestic smoke is worst.

Another serious problem which the commission is attempting to solve is the making of coke in open heaps from stolen raw coal. About 50,000 tons of this coal is stolen each year and made into soft coke, and the smoke in the district where this occurs causes the deaths due to respiratory diseases of 19 per 1,000 compared with 3 per 1,000 for a clean district. While it is felt to be impossible to stop the coolies from taking coal for their own use, the manufacture of soft coke for sale is being stopped.

The commission is urging the substitution of gas and electricity in place of raw coal for heat and power in an effort to further eliminate the smoke nuisance.

How to Detect Cracked Turbine Blades

CRACKED turbine blades are a menace to a turbine and sometimes to the safety of the operators and should be watched for carefully when a turbine is down for its annual or periodic inspection. Cracks are not always easy to find, and where possible one of the manufacturer's service men should be called in if blade trouble has been experienced. These men know what to look for and can find cracks and defects which otherwise might pass unnoticed.

In districts where such men cannot be readily obtained, however, it is possible to do a fairly good job, if care is exercised. First the blades should be given a good washing with kerosene. They should then be wiped off and a mediumly thick coating of whiting applied. The kerosene finds its way into the cracks during the washing and when the whiting is applied the kerosene soaks out and discolors it, making it easy to detect cracks.

In one central station where they have had considerable trouble with cracked blading, the turbine spindle, after the whiting is applied, is vibrated by a small air hammer. This has proved an effective way of finding all cracks, because it shows up the small ones. The air hammer must be used cautiously, however, for it tends to set up such violent vibrations that it is possible to damage the blades if used too vigorously.

Steam Turbine Well Adapted to Laundries' Power Needs

Points in its favor include economy of space, lower first cost, exhaust free from oil and low upkeep

By S. M. Culbertson
Secretary, Ideal Laundry Company
Denver, Colorado

IN LAUNDRY plants where the steam needed for heating wash water is equal to, or more than, the exhaust from the turbines, the use of this type of prime mover is advantageous. Indeed, if the owner is following the L.N.A. (Laundry-owners' National Association) recommendations of heating all hot water before it enters the washers to between 180 and 190 deg. F., he need not fear that any turbine of reasonable economy will give more exhaust than is needed to heat the water.

The exponents of highly economical reciprocating engines advance the argument that if the exhaust is not sufficient to heat the water to the desired degree it is always possible to add live steam by means of a thermostatic valve to produce the required temperature, and this is, of course, true. But as long as the turbine does not produce more than enough exhaust, it will also require a thermostatic valve supplying steam to the hot water.

There are four points that may be advanced in favor of the turbine; namely, (1) economy of space, as already noted; (2) much lower first cost; (3) an exhaust that is entirely free from cylinder oil; (4) low maintenance cost.

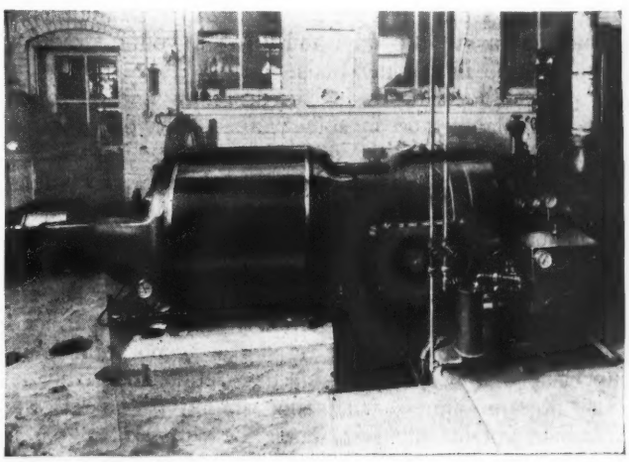
The writer's first thought was that a bleeder type might be used having an initial pressure of, say, 125 lb.; bleeding steam for flat work ironers, etc., at 100 lb.; and further bleeding at 20 lb. for the washing machines, with the final exhaust going to heat the water. In this way all steam employed in the plant would first be used to supply power. A pretty enough picture and a possibility; but upon investigation it was found impractical because it required a special type of bleeder turbine not of stock design, making, therefore, a prohibitive first cost. Furthermore, if the exhaust from a standard non-condensing turbine is nearly sufficient for hot water requirements and all the power required by the plant is generated by the turbine, there exists as perfect a balance as necessary.

Turning to the plain two-stage non-condensing turbine (which fills all the requirements) and examining its application to the needs of the Ideal Laundry Company of Denver, Colorado, as a typical installation, it was found upon a survey prior to the turbine installation that 68,000 lb. of water per hour was being heated from 59 to 153 deg. F., which required 6,060 lb. of steam per hour. This was supplied by the exhaust from a 75-kva. automatic engine supplemented by a 1-inch live-steam line into the exhaust line and a ¾-inch thermostatic valve direct to the hot-water tank. Live steam to the extent of 380 lb. per hour was used to increase the temperature of the make-up water from 153.6 to 190 deg. Thus there was a total consumption of steam for water heating of approximately 6,400 lb. per hour. The engine-generator delivered an average of 69 kw. per hour, and 17.7 kw. per hour was being purchased from city lines, making a total power use of 86.7 kw. per hour average.

The guaranteed water rate of a 200-kw. G.E. two-stage turbine at 100 lb. initial pressure, no superheat, and 5 lb. back pressure, running at 90 kw. load, is approximately 6,000 lb. per hour. As the calculated load would be slightly below this and the steam needed for water slightly above it, there appeared to be a good balance, and a 200-kw. turbine-generator was purchased, thus taking care of the present needs and allowing a margin of 100 per cent for future needs and practically doing away with the use of purchased power. This installation has proved entirely satisfactory during its six months of service.

Close Balance Maintained Between Steam Demand and Power

The maker's guarantee has been exceeded, the steam consumption being as low as 62 lb. per kilowatt-hour at 85-kw. load, the wash water being kept at an average temperature of 155 deg. F. with the assistance of a thermostatic valve. No back pressure is shown on the exhaust gage, notwithstanding the fact that the exhaust is carried by a 5-in. line instead of an 8-in. line, as was specified by the turbine builder. This favorable condition is probably due to the use of a Dillon exhaust head heater with circulating features which induce a partial vacuum. The steam consumption of the turbine is checked by a Bailey flow meter, but, as the saying is: "The proof of the pudding is in the eating"; and, if there is ever any steam escaping from the exhaust head heater, there is loss with this installation. There has never been any steam exhausted to atmosphere except for about twenty minutes on Saturday mornings, when work in the washroom is extremely slack. There would be a little loss of exhaust



This 200-kw. turbine-generator supplies power and steam to the Ideal Laundry Company at Denver

on Saturday afternoons, if the turbine was operated after the washroom is shut down and other departments are kept running. However, this condition is taken care of by turning the entire power over to city lines and shutting down the turbine. Some of the readiness-to-serve charge is absorbed in this manner. In this connection it may be said that every laundry plant should have a stand-by unit or else should be equipped with city line connections. It is cheap insurance. The city line connection has far less first cost than has a duplicate unit, occupies no space, and the readiness-to-serve charge is not greater than the depreciation on this extra unit when decrease of coal consumption is also taken into consideration

Right Out of the Plant

Stopping Lubricating Oil Trouble

ABOUT three years ago we purchased a 120-hp. four-cylinder two-stroke-cycle oil engine with force-feed bearings; the cylinders were 8¼ x 12 in. This engine started to pump lubricating oil past the oil rings and out the exhaust at the rate of three to four gallons every 24 hours.

To correct the trouble I purchased a No. 500 cylinder hone. With this hone in an electric hand drill I worked down all high spots in the cylinder, giving the cylinders a highly polished surface. This, of course, gave the pistons more clearance. Then the pistons were sent to the machine shop and had the high spots ground off, also an extra oil grooving was turned above the old ones in the pistons.

I then used hammered oil-slot rings in place of the grooved ring and added splash plates fastened to the doors of the crankcase.

This engine now operates with about three-quarters of a gallon of lubricating oil for the crankcase and cylinder lubrication per 24 hr. and has been doing so for eight months without any trouble.

Baltimore, Md. GEORGE WIRKOW.

The Young Engineer and the Boiler Room

IN THE Aug. 13 number of *Power* there was a question as to the advisability of a young graduate seeking a job in a boiler house.

Power engineering means the designing and operation of power plants, and in some respects the operation is more important than the designing, for the best of designs badly operated will yield wretched results. Presumably the questioner has studied plant design to some extent, but it is certain that he knows little about operation, unless he has worked in a plant for some time. That is why employers insist that a beginner work in the plant, and the beginner should welcome the experience.

An engineer in charge of power generation must supervise operating men, and to do this effectively he must not only know what they should be able to accomplish, but he must command their respect. To this end it is important that they know him as an expert operator himself.

In some respects, boiler room operation requires more skill than anything else in the plant. The plant supervisor must possess that skill if he is to do his work fully and effectively. The only way he can develop such skill is by actually working in the boiler room. Experience indicates, however, that the trained engineer, with his active mind and technical background, can develop adequate experience in a few months of operating work. He need not spend years in the plant.

The beginner should look upon such plant work as an opportunity, not as a burden. To be sure, it may be hot, dirty work, but all engineering, in the last analysis, rests upon such work, and the engineer who is unwilling to dig in with his own hands, at least in his early years, is not worth his salt. These first years of practical work should be entered upon with enthusiasm and a determination to master every detail of the work. On such work he can build a structure of genuine engineering skill that can be based on no other foundation.

Another thing these years of plant experience will do for the man: It will bring him into intimate contact with the plant operators. From them he will learn much of high value, and perhaps nothing so important as their mental outlook, their life problems. The manager who has learned at first hand that the men under his control are men of like passions with himself, who has learned to respect them and their ambitions and yearnings, is thereby a vastly better manager. After all, the most precious material that goes into engineering enterprises is the lives of men, and the engineer who would do justice to his whole job must know how men live and what they live for. He must have been one of them, for a time at least. Men who have done this find that they always remain "one of the gang," and happily so, and they find further that this position is of inestimable advantage to them.

A few words of practical detail: Let the young engineer enter upon these months or years of plant work whole-heartedly and without reservations. For a time let him cease to be the college graduate, and be simply a man among men. He must, if he is to secure the maximum benefit from his plant work, avoid every appearance of separateness. Let him dress in the same locker room with the plant men. Let him eat his meals where they do. If they carry a dinner pail, let him carry one. If they have a dark, unsatisfactory washroom, let him use it in common with them. If they come to work at awkward hours, let him do the same, and be as punctilious as they are required to be about lateness, absence, overtime and Sunday work, and all that. In short, let him be one of them in every detail. And if he be a real man, they will come to admire him and perhaps to love him, and he will find bonds of friendship springing up that he will count priceless as the years accumulate. His friends on the job will rejoice when he moves up to broader responsibilities, and he, if he be a true man, will not forget his former "pals" but will ever be ready to consider sympathetically their grievances and to rejoice in opportunities to lighten their labor or to increase their rewards. They, confident in his friendship, will serve him more effectively and contentedly. Thus only can be broken down the too frequent attitude of sullen opposition between labor and management that costs many a firm far more money than it realizes.

Let the young engineer go after that boiler room job as the best thing that ever came his way. Let him go in and prove himself a man, and he will bring from it a man's reward. I fear that he has not freed himself of the stigma that attaches to many engineering graduates, the stigma of the white collar. The question smacks of a snobbish dislike of real work. This is no attitude for an engineer. The sooner he puts it behind him, the better for his prospects in life.

C. HAROLD BERRY,
Professor Mechanical Engineering,
The Harvard Engineering School.

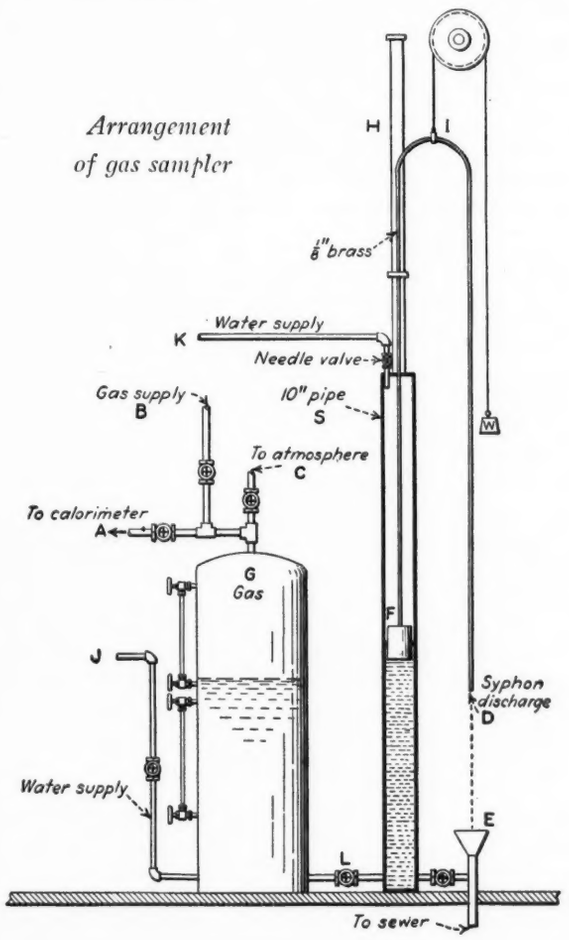
Cambridge, Mass.

A Continuous Gas Sampler

WITH reference to the article in the July 2 number of *Power,* showing a continuous gas sampler, we have built a sampler for the same purpose which we think is a more satisfactory type, especially where only low pressures are available and a continuous sample is desired.

From the sketch shown in the article referred to, the sampler does not have a constant rate of discharge on the water, because the head pressure is constantly changing, while in our sampler the rate of discharge on the water is constant at all times, thus giving, in our opinion, a true average sample. In our plant we want an average over a week's time, and we find this tank gives a satisfactory sample, and when we want a 24- or 8-hour sample it is only necessary to change the rate of discharge.

We use a round galvanized-iron tank, 7 ft. high and 30 in. in diameter. The letters in the sketch show the method of operation as follows: *A*—Gas connection to calorimeter. *B*—Gas connection from the gas supply. *C*—Valve which can be opened to the atmosphere and the tank completely filled with water. *D*—Discharge of the syphon (this syphon is made of ⅛-in. brass pipe and is



attached to the float *F* and counterbalance *W*, giving a constant discharge of water from the standpipe *S*, which is cross-connected to the main gas holder *G* by pipe *L*). *E*—Funnel to carry the discharge water to the sewer or hot well. *F*—Copper float which fits loosely in the 10 in. standpipe. The float is approximately 10 in. in diameter and 12 in. high, with the syphon inlet at the bottom). *H*—Guide rail for the syphon to slide on.

The water supply to the standpipe *S* is regulated by a needle valve. The rate of the water entering the standpipe determines the net time required to empty the tank. In our case, for one week's operation, the syphon discharges 2½ lb. of water per minute, while the inlet *K* puts 2¼ lb. back in the standpipe, leaving the net discharge ¼ lb. per minute. With ordinary care this sampler gives satisfactory results and a truly representative sample.

PAUL SPEER.

Kansas City, Mo.

High-Pressure Drums in Quantity

THE question of high-pressure forged drums, which was commented upon in the Aug. 20 issue of *Power,* brings to mind the fundamental points that should be considered in the construction of such high-pressure equipment.

Whatever type of boiler drum is used, its safety depends on three fundamental factors, namely, the quality of the materials used, the design or shape of the drum, and the method of its fabrication. Therefore, the thought contained in the above editorial, that manufacturers of boiler could do well to purchase their drums from those best equipped to produce them, is very appropriate.

On the subject of material, I believe the best method of forging the walls of pressure vessels is to use the rolling mill, which can do the forging operation in one heat. In this manner uniformity of wall thickness is assured. Plates thus forged can be rejected for flaws without a great economic waste of plant energy. Such a forging can also be cropped sufficiently to eliminate the undesirable parts of the ingot.

Individual plates as compared to a single large forging are also desirable from the point of design, since they can easily be shaped to correct dimensions with precision. But the matter of design is not ended with the cylinder proper. Nozzles, heads and other details cannot be economically forged to the correct shape from the solid ingot. Yet if the shape is not right or sections not proportioned relative to the load imposed, then the forging is lacking in one of the fundamentals of a perfect vessel.

Now if safe methods of joining such parts can be developed, then the third vital quality factor, namely, that of fabrication, is properly taken care of and in balance with the most desirable material together with correct shape and design.

It is an established fact that there are available adequate methods of joining the parts which can produce strength and ductility equivalent to that of the material in the plates themselves. Such a method is welding; but it is necessary to have a proper understanding of the art in order to obtain uniform and dependable results.

That the application of welding is new and untried is no longer true. The company with which the writer is connected is now in its fifth year supplying large welded vessels for a service more severe than that to which the steam drum is subjected. More than 1,000 of these vessels are now in service.

Incidentally, it might be added that the most effective way to insure safe equipment is to apply adequate testing methods to the finished drums and their outlets and reinforcements.

T. MCLEAN JASPER.

Milwaukee, Wis.

Caustic Soda Alone Does Not Cause Cracking

IT WAS with considerable interest that I read the report of the recent convention of the National Board of Boiler and Pressure Vessel Inspectors containing the remarks of J. C. McCabe of Detroit, which appeared in the July 23 number of *Power*. I consider that the conclusions reached by Mr. McCabe are more representative of the facts of the cracking of boiler plate in riveted seams than attempts to explain it by the presence of caustic soda in the water.

Particularly was I interested in the second conclusion in the box on page 148, that "caustic soda will contribute to and hasten the cracking of already overloaded metal." I take this to mean that Mr. McCabe does not consider caustic to be the cause, but rather an accelerator of the effect of another and quite different cause.

I have been drawn to the same conclusion by consideration of the somewhat analogous condition of seasonal cracking in condenser tubes. A standard test for ascertaining that the molecular structure of the tube is such as to minimize the probability of seasonal cracking is to immerse a sample of the tube in a mercurous nitrate solution. I am of the opinion that caustic affords a similarly accelerated test in the case of improperly treated boiler plate. Sufficient examples exist of plate exposed to caustic solutions without the occurrence of so-called caustic embrittlement as to make the hypothesis questionable, and the researches of R. Baumann in Germany have also thrown doubt on the view that the condition is due to the presence of caustic in the boiler feed water.

In this connection I desire to call attention to a paper entitled "Notes Concerning Fractured Boiler Plates," presented by Messrs. Ness and MacCallum to the West of Scotland Iron and Steel Institute, Session 1927-1928. After discussion of Bulletin No. 155 entitled "The Cause and Prevention of Embrittlement of Boiler Plate," published in 1926 by the University of Illinois engineering experiment station, the paper concludes:

> The experience of the contributors is that all the defects hitherto met by them in practice can be traced to purely mechanical causes as the origin of the fractures.

In the discussion which followed, Dr. A. McCance remarked that "the main conclusions that the authors have drawn were correct, namely that caustic embrittlement, as far as ordinary boilers were concerned, had practically nothing to do with the fractures which they had shown"; and further that "it had been found that certain boiler plate material which left the works in an apparently tough, sound and satisfactory condition, after the lapse of time became brittle and its impact value decreased, and it had also been found that this reduction of toughness resulted as a consequence of cold work, or mechanical deformation. In many boilers materials which were mechanically deformed would lose their toughness rapidly, especially when heated to the temperature at which the ordinary boiler is working. A matter of a few minutes at an appropriate temperature would reduce what was a satisfactory and tough material to the most brittle and dangerous condition. This material would get brittle without the necessity for corrosive influences being at work at all. The corrosive influence of ordinary water, in any case, was enough as an additional danger without dragging in caustic soda. Under the influence of corrosion, cracking (where the tendency for cracking existed) would be greatly accelerated, and eventually cracks that might become dangerous in the course of, say, five or six years, reached this state through the action of corrosion in a matter of a few months."

Whatever the cause may be, there appears to be little escape from Mr. McCabe's conclusions that "riveted boiler joints must go," and "the use of welded joints in boiler drums is inevitable." It is to be hoped that the trend of modern thought in connection with boiler construction will come to the attention of the Boiler Code Committee in such a manner as to enable it to remove from the code at least some of the unnecessarily onerous conditions now surrounding the use of welded joints in boilers and other pressure vessels. H. BOYD BRYDON.

Chicago, Ill.

Overcoming Hot-Weather Lubrication Difficulties

LUBRICATION troubles may be expected to increase somewhat during the hot summer months on account of the decreasing viscosity of the oil with increasing temperatures. In many cases it is difficult to differentiate between cause and effect, and often the only way to discover the actual cause of the trouble is to make a thorough investigation as described by E. R. Woodward in the July 23 number of *Power,* in his discussion "on the Cause of Burnt-Out Bearings."

The effect of summer temperatures is less important, of course, where a circulating system is employed to insure an adequate and continuous flow of oil. It is often well with such systems, however, to increase the circulation during the hot weather.

It is particularly important to test all oils for emulsification with water. The highly fatty oils used in steam cylinders have a way of working into the circulating oil supply, causing it to emulsify with the water to an objectionable extent. Proper filtering will extend the life of an oil enormously.

I recall many instances where flashovers of synchronous converters caused incessant trouble with bearings, as the heavy current rush from the brushes to the shaft and thence to the pedestal, frame and earth caused rough spots in the bearings and led to a shutdown. This problem was finally solved by placing a couple of rings on the shaft and grounding the shaft to the machine frame with a conductor of ample capacity. In this way, any flashovers or short circuits to the shaft are carried off directly through the conductor instead of breaking down through the oil film in the bearings.

The possibilities of deflocculated graphite for emergency bearing troubles are not fully appreciated. A little graphite fed to the bearing so that the rotating shaft draws it in will frequently enable a hot bearing to cool down sufficiently to remain in service until attention may be given to it. The graphite fills up the pores in the bearing metal, thus lowering the coefficient of friction and heating. Moreover, it helps to maintain the oil film between bearing and shaft, especially when the viscosity of the oil has decreased on account of high temperatures. It is important not to use too much graphite, however, otherwise the oil pipes may become clogged up. About one-half of 1 per cent by bulk of graphite will usually be found sufficient. I have also found graphite useful in other instances, such as when starting new machinery.

Chicago, Ill. M. C. LANGFELDER.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

New Packings for Acids, Alkalies and Petroleum Products

THREE new kinds of packings, designated "Cutno," "Pelro" and "Palco," have been added to the line of packings put out by Greene, Tweed & Company, 109 Duane St., New York City.

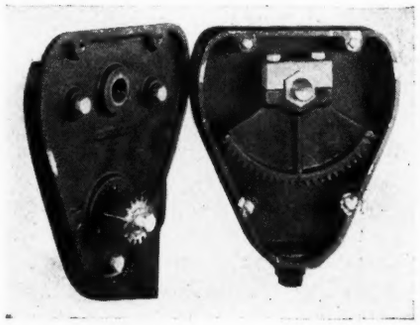
The Cutno packing is especially designed for use on pumps and other equipment where ammonia, caustic soda, hydrochloric acid, sodium carbonate and similar chemicals are handled. The Pelro is suitable for use with gasoline, naphtha, alcohol and similar liquids, and the Palco line for hydraulic pressures, with water, hot or cold, and calcium brine.

Each form of packing is impregnated with a lubricant which resists the washing out tendency of the fluid pumped. The packings are available in braided form in sizes from $\frac{1}{8}$ to 2 in. and in twists from $\frac{1}{16}$ in. to $\frac{1}{2}$ inch.

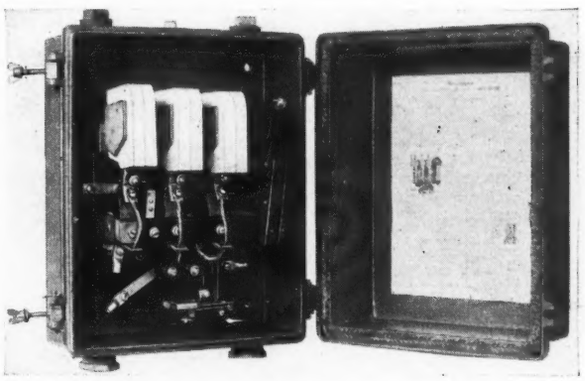
Drum Switch-Operating Mechanism

A NEW type of operating mechanism for use with drum switches mounted in crane cabs and similar places is announced by the General Electric Company of Schenectady, N. Y. This mechanism, which supersedes the rack-and-pinion under-lever type, is designed to eliminate the trouble usually experienced in keeping a perfect line-up between the shaft of the operating mechanism and the drum switch shaft, and to make it possible to close the mechanism to keep dirt from the gear lubricant.

Switch mechanism with gear case open



The device consists of a pinion on an extended drum switch shaft, meshing with a segment gear, all housed in a dust-tight casing, which has a plugged access hole for gear slushing and with a short level arm projecting below the case. The lever arm can be connected with the reach rod in the same way as with the old rack-and-pinion type. The gear ratio is such that the movements of the operating lever are nearly a straight line for the reach rod. The lever is laid out to give a linear travel equal to older designs.



Dust-tight line starter fitted with gasket seal on door, and threaded conduit connections

Dust-Tight Line Starter

A LINE of dust-tight, weatherproof line starters in three sizes up to 50 hp. is announced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The starters are of the remote-controlled, non-reversing, across-the-line magnetic type designed for use with single-phase and polyphase squirrel-cage induction motors.

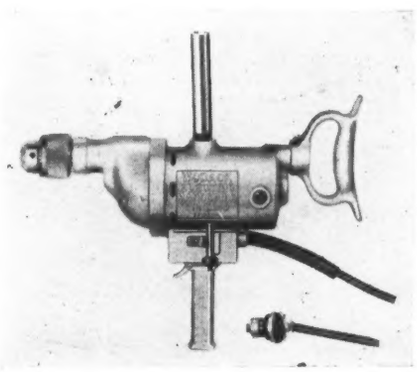
The new line differs from the other types in its cabinet construction, a cast-iron cabinet being used with a gasket seal on the door. The conduit is brought in through the top and bottom in threaded openings to make a dust-tight connection. The starters are also equipped with the deion grid-type arc quencher.

To prevent the operator from breaking the seal whenever the motor is put back in service after an overload, the two smaller size starters are equipped with an automatic reset thermal overload relay. The relay has interchangeable heaters, accessible calibration lever and quick make and break contacts.

All-Purpose Electric Drill

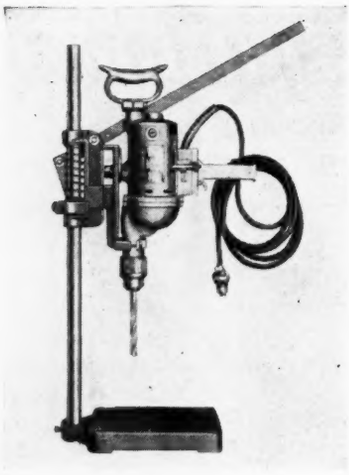
A PORTABLE electric drill suitable for general drilling and for use with a bench stand is illustrated.

The drill is equipped with a motor built for direct or alternating current of 60 cycles or less, 110-125 or 220-250 volts as desired. An oversize double-pole trigger switch is mounted in a convenient position on the drill. Anti-friction bearings are used, with the heavy thrust loads carried by roller bearings. Speed reduction between the motor and the drill is through hardened gears running in grease-filled casings. Ventilation is by an oversize fan for quick cooling during idle running.



Portable electric drill

The drill has a capacity up to $\frac{5}{8}$ in.



Drill mounted on bench stand

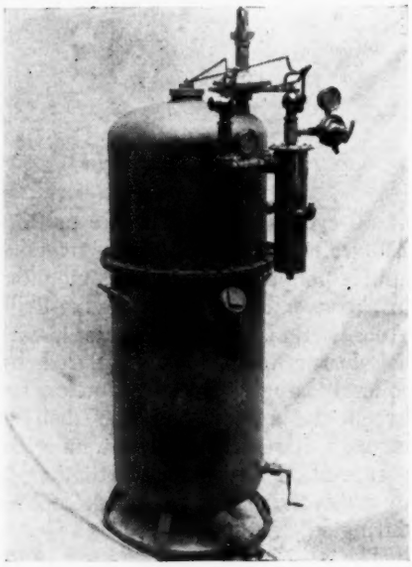
in steel and up to 2 in. in wood, depending on the kind and on the depth required. It is put out by the Wodack Electric Tool Corporation, 4627 West Huron St. Chicago, Ill.

Portable Acetylene Generator for Welding and Cutting

THE portable acetylene generator for welding and cutting illustrated is made in three sizes, 35, 70 and 100 lb. capacity. The body of the machine is made of drawn seamless steel. Uniform carbide feed and complete combustion of the charge are claimed by the manufacturer, the Alexander Milburn Company, Baltimore, Md.

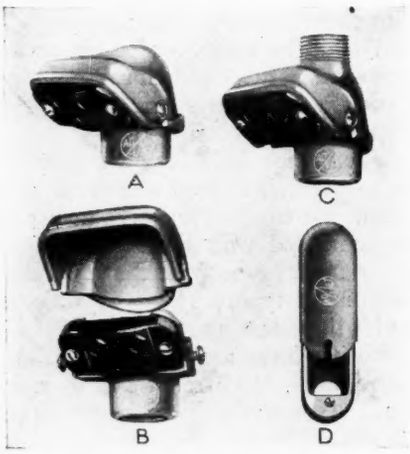
Simplicity of operation and few moving parts are other features of the generator. The carbide hopper feed control and head are assembled in one unit. The carbide feed is controlled by a single valve, which responds to high or low pressure and automatically stops if the pressure is at zero, or if the filler plug is open or the generator not properly closed. The machine is equipped with blow-off valves, pressure control, safety gas purifier and strainer. It also has handles for transportation.

Generator assembled complete with control equipment



New Line of Conduit Fittings

A COMPLETE line of conduit fittings of a new design in which the composition cover need not be removed to pull the wires is now being put out by the Adalet Manufacturing Company, 4610 St. Clair Ave., Cleveland, Ohio. Three types of the fittings are illustrated.



Each fitting has a removable metal cover

Each fitting is equipped with a cover which when removed allows the wires to be pulled practically straight through the fitting. Then the ends are pushed through the composition cover, instead of the cover having to be threaded on after the wires have been pulled in. The views *A* and *B* show the standard service entrance fitting assembled and with the cover removed, respectively. The fitting shown at *C* is known as a meterlet, and the one at *D* is a service entrance ell. This ell offers the advantage that it holds the conduit close to the building and has a reversible cover. Both ends of the fittings are drilled and tapped for the cover-locking screw. When necessary to reverse the cover the locking screw is moved from one end of the fitting to the other. These ells are also available with a spring-locking cover, so made that when the cover is closed it cannot be reopened without so damaging it that tampering is at once apparent.

Safety Control for Motors and Other Equipment

THE safety control illustrated is suitable for use with practically all types of electricity-consuming devices, whether alternating current or direct current and with practically all types of magnetic, thermostatic or pressure primary control units. It differs from the regular across-the-line starting switch in that it is connected in but one side of the circuit and the coils are energized only momentarily during the period of operation.

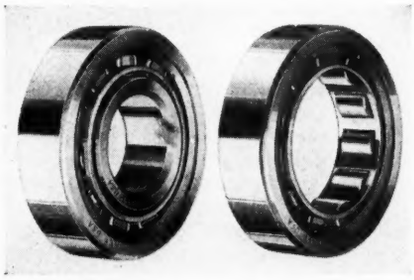
The device consists essentially of two electromagnets and a main load contactor. The closing coil (the lower one on the panel) when energized by the control unit draws the main contactor closed, where it is locked in position by a latch. The contactor then is opened only by energizing the upper coil, which lifts the latch and frees the contactor.

It is claimed by the manufacturer that the control does not chatter through vibration or drop in voltage. Also that the coils cannot overheat or burn out through overload or varying voltage, because they are never in circuit except at the moment of performing their function. No transformer is required with the load or control contacts. The control is put out by the Ross Safety Switch Corporation, 1 East 42nd St., New York City.

Safety control panel

New Radial Roller Bearing

TO MEET a demand for a roller bearing interchangeable with standard single-row ball bearings but having greater capacity the Hyatt



Bearing assembled and with inner race removed

Roller Bearing Company, Newark, N. J., has brought out the single-row radial bearing illustrated.

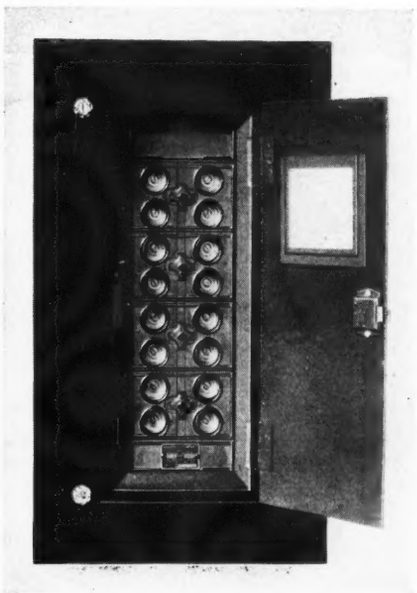
The new line of bearings, which uses solid rollers, is not intended to replace the standard Hyatt bearing, which uses spirally wound rollers, but is offered as a supplement to it, for positions in which space limitations exist and loads beyond the capacity of ball bearings must be sustained.

In the new bearing the rollers are permanently retained with the outer race, the inner race being separable. A separator floating on the rollers spaces them properly, and end rings keep them in alignment. The rollers and races are made of a special chrome nickel alloy steel and the end rings are of vanadium steel.

Unbreakable Resistor

VIBRATION-PROOF, unbreakable, non-corrodible and light weight are some of the advantages claimed for "Dur-ristor," a new unbreakable resistor with a continuous resistance element, recently announced by Cutler-Hammer, Inc., Milwaukee, Wis. The new resistor is especially designed for service under severe operating conditions.

The resistance element consists of two continuous strips of a rust-proof, non-corrodible alloy proportionally ribbed on the sides and on the turning edges. A new method of supporting the strips, combined with the ribbing, permits the strips to expand and contract freely during temperature changes, and the entire resistor, it is claimed, is made unbreakable and permanent by the elimination of brittle material and by the use of mica for all insulation. All Dur-ristors, regardless of ampere rating, are of equal size, the thickness of the resistance strip being the only part that varies in size according to ampere rating.

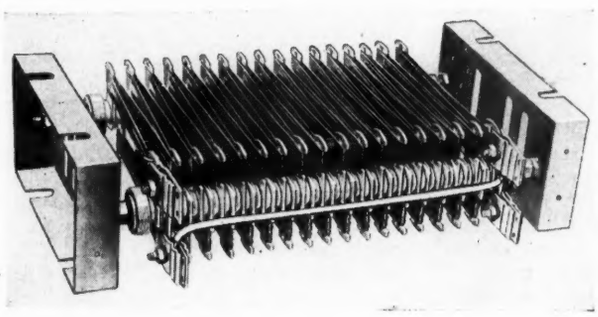


Narrow panel board with four-plug fuse section

Narrow Lighting Panel Boards

A FULL line of narrow lighting panel boards has been added to the electrical control equipment put out by the Square D Company, Detroit, Mich.

The new boards are only 12 in. wide over-all (6-in. panel and 3-in. gutter all around), which allows them to be used where the larger boards could not be installed owing to space limitations. They are built in capacities up to 100 amp., with all copper busbars of standard size. They can be supplied with cartridge as well as plug fuses, and switched circuits as well as fused can be furnished in the branches. Where both switches and fuses are supplied, the switches are of the tumbler type of 30-amp., 250-volt rating.

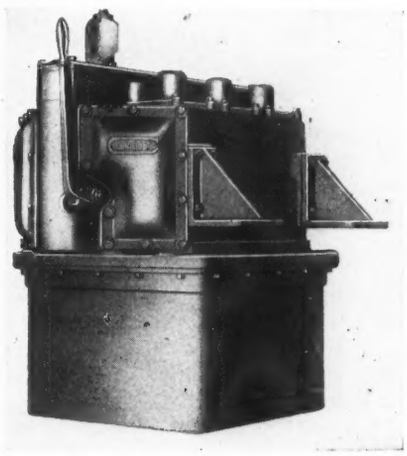


Resistor with non-corrodible resistance element

Oil Circuit Breaker for Underground Service

IN THE oil circuit breaker (designated type M-210) for underground distribution service brought out by the Condit Electrical Manufacturing Corporation, Boston, Mass., a light, rapidly accelerating mechanism is used to give high-speed characteristics and easy operation.

The operating mechanism, bushings and current-carrying parts are supported by a heavily reinforced frame structure. Individual tanks per pole are provided of welded steel plate. Space is provided in the upper part of the frame for two bushing-type current transformers per pole, in connection with which up to six trip coils can be furnished. Lead-covered



Manhole oil circuit breaker

cables enter at the top through sleeves with wiped joints, and then terminate in a compound filled pothead inside the breaker, from which porcelain insulators extend below the oil line. There are no exposed current-carrying parts above the oil line.

The breaker illustrated is furnished manually operated, three-pole, single-throw for 400 amp. at 15,000 volts, non-automatic or full automatic, with an estimated interrupting capacity of 60,000 kilovolt-amperes.

FROM AMONG READERS' PROBLEMS

Conducted by L. H. MORRISON

CORRECTING STEAM RATES—*How would you correct the actual weighed steam consumption of a cross-compound engine operating at 155 lb. gage and 24 in. vacuum, quality of steam 0.99, to the equivalent consumption if operated at 150 lb. and 26 in. vacuum?*

H. G. M.

This question can be best answered by finding the steam consumption that a perfect engine (the Rankine-cycle engine) would have when operating under the two different sets of conditions.

In the Rankine, or perfect engine, there are no cylinder losses, and the steam expands to the back-pressure line. The heat converted into work is the difference between the heat in the steam reaching the engine and the heat in the steam leaving the engine, or $W = H_a - H_b$, where

H_a = total heat in a pound of steam at the initial conditions.

H_b = total heat in a pound of steam at the exhaust conditions.

The heat in a pound of steam at 155 lb. gage, (170 lb. absolute) and 99 per cent dry as measured from water at 32 deg. F. is $H_a = h_a + X\ L_a$, where h_a is the heat of the liquid, L_a is the heat of vaporization and X is the per cent of dryness, or the quality. From Marks & Davis's steam tables, at 170 lb. abs., $h_a = 340.7$ B.t.n.; $L_a = 854.7$. So $H_a = 340.7 + 0.99 \times 854.7 = 1186.8$.

Now upon expanding the steam becomes wetter, so that while the heat in the steam is found by the same formula, $H_b = h_b + X\ L_b$, we do not know the value of X. To find X, the per cent of dryness of the steam at the end of expansion, one makes use of the entropy value, which remains constant in an adiabatic expansion. At 170 lb. the entropy of dry steam is 1.5590, of which 0.5269 is the entropy of the water and 1.0321 is the evaporation entropy. But the initial steam is only 99 per cent dry, so the total entropy of the steam is $\phi = 0.5269 + 0.99 \times 1.0321 = 1.5487$.

At 24 in. vacuum the entropy of dry saturated steam is approximately 1.8880, of which 0.1984 is that of water and 1.6896 is the entropy of evaporation. But the entropy of the actual exhaust steam is 1.5487, so $(1.5487 - 0.1984) \div 1.6896 = 0.8$, or the steam is 80 per cent dry. Inserting this in the equation for the heat in the exhaust steam we have $H_b = h_b + 0.8\ L_a$, and since the work is the difference between the two total heats, we have

Heat converted into work $= H_a - H_b = h_a + X\ L_a - (h_b + X\ L_b)$, or $1186.8 - (107.8 + 0.80 \times 1{,}013) = 268$.

As an indicated horsepower-hour is equivalent to 2,545 B.t.u., the perfect engine working between the two limits would use $2{,}545 \div 268 = 9.5$ lb. per horsepower-hour.

If the steam pressure is 150 lb. gage, or 165 lb. absolute, 99 per cent dry, and 26 in. of vacuum, the same process as outlined will show that the perfect engine would use 7.4 lb. per horsepower-hour.

The correction factor to use on the actual engine, assuming its efficiency relative to that of the perfect engine is constant, would be $\frac{7.4}{9.5}$.

PRESSURE ON A STAYBOLT — *How much is the total load on a staybolt of a boiler when the staybolts are 5 x 6 in. apart; the boiler pressure is 175 lb. gage?*

R. M. Q.

The area supported by each stay is, obviously, 5×6 in., a total of 30 sq.in. If the boiler pressure is 175 lb., the total load on each bolt is $175 \times 30 = 5{,}250$ lb.

However, no account has been taken of the area of the staybolt and, of course, the pressure in the water leg is not exerted on the area filled by the bolt. If the bolt is 1 in. in diameter its cross-section has an area of 0.7854 sq.in. and the *actual* area supported by each staybolt is $30 - 0.7854$, and the total force is $175 \times (30 - 0.7854) = 5{,}107$ pounds. The stress is equal to $5.107 \div 0.7854$, or 6,500 lb. per square inch.

PREVIOUS QUESTION

DISCUSSED BY READERS

THE QUESTION

ASSUMING that a boiler is operating at 400 lb., will the feed pump do more work if the feed-water heater is placed between the boiler and the pump than if the pump is between the boiler and heater, assuming that the feed water is raised to 300 deg. F. from a hot-well temperature of 100 deg. F.?

THIS question contains a "joker" which might be overlooked in basing an answer on theory alone. The boiler feed pump would be required to do less work when placed between the heater and the boiler, because to pump water at 300 deg. F. without steam binding the pump's suction pressure must exceed 53 lb. gage; preferably the positive pressure on the pump suction should be a minimum of 65 lb. gage. Water at 300 deg. F. would flash into steam at any pressure less than 53 lb. gage, and if either heater or boiler-feed pump is to operate, the pressure up to the pump suction must exceed this pressure by a reasonable margin. The work done by the boiler-feed pump would therefore be less than if it were installed before the heater. In that case the suction pressure of the boiler-feed pump could be as low as 4 or 5 lb. without danger of flashing, and the range of head through which the water is pumped would be from 5 to 420 lb. or 415 lb. In the former case the range would be from 65 to 420 lb. or only 355 pounds.

The reduction in boiler-feed pump work, however, would be at the expense of increased load on the hotwell pump which would be required to deliver water through the heater at 65 lb., but in the other case, to the feed pump direct, at only 5 pounds.

The total work of both boiler-feed and hotwell pumps would probably be slightly higher, depending upon the pump designs and system layout. The increase in total work with the boiler-feed pump between the heater and the boiler would be the result of increased friction through that pump because of handling a larger number of cubic feet of water, the same weight of water having a greater volume because of its higher temperature.

It might be added that all standard practice would call for placing the heater between the boiler-feed pump and the boiler.

G. V. WILLIAMSON,
Ass't. to Ch. Engr. of Pr. Plants.
Union Electric Light and Power Co.
St. Louis, Mo.

THE question presents an impracticable proposition in that it is impossible to prevent a boiler-feed pump becoming vapor-bound when handling water above 212 deg. F., with even a very small suction head on the pump.

However, assuming the plan of putting the heater between the pump and boiler were feasible, the following illustration and calculations show the work done by the feed pump in each case.

All heads indicated are in feet; r_1 represents loss in head through the heater, r_2 and r_3 are the friction losses

through piping. The head is 400 lb. per sq.in. = 924 ft.; W is the weight of water.

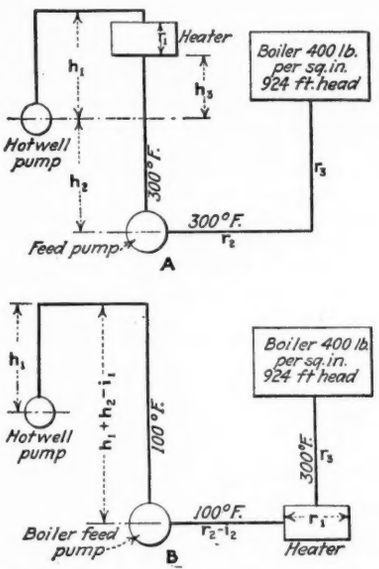
With the pump between the heater and the boiler as at A, the work done

by the hotwell pump $= \frac{W \times h_1}{33{,}000}$

and the work by the feed pump $= \frac{W\,[924 + r_2 + r_3 - (h_2 + h_3)]}{33{,}000}$

Since $h_3 = h_1 - r_1$, we can write the work by feed pump $W\,[924 + r_2 + r_3 - h_2 - h_1 + r_1]$ hp. $= W\,(924 + r_1 + r_2 + r_3 - h_1 - h_2)$.

Since water at 100 deg. F. weighs 62.02 lb. per cu.ft. and at 300 deg. F. weighs 57.33 lb. per cu.ft., with the heater set between the pump and the boiler, the friction in the suction pipe



Illustrating the two methods of hook-up

will be reduced by an increment i_1, due to the decreased volume per unit weight at 100 deg. F., and the frictional resistance in the pump discharge will be decreased by an increment i_2 for the same reason.

If the heater is between the pump and boiler the work done by the hotwell

pump $= \frac{W \times h_1}{33{,}000}$ hp. and the work done by the boiler-feed pump $= \frac{W \times [924 + r_3 + r_1 + r_2 - i_2 - (h_1 + h_2 - i_1)]}{33{,}000}$

$$= \frac{W\,(924 + r_1 + r_2 + r_3 - h_1 - h_2 - i_2 + i_1)}{33{,}000}$$

Difference in work done by the pump when handling 100 deg. feed water instead 300 deg. feed water is

$$\frac{W\,(i_1 - i_2)}{33{,}000} \text{ hp.}$$

Thus if the frictional resistance drop in the discharge pipe is greater than the frictional resistance drop in the suction pipe when the pump handles 100-deg. water, less work will be done by the pump than when handling 300-deg. water.

R. F. FORBES,
Research Department,
Indianapolis Power & Light Co.
Indianapolis, Ind.

WITH 100-deg. water on the suction side of the pump, the suction pressure may be atmospheric without "flashing," whereas with 300 deg. water on the suction, the pressure must be over 67 lb. to prevent flashing. Consequently, with the same boiler pressure in each case, the pump will do less work when its suction pressure is higher.

With the high suction pressure obtaining also in the case of 100-deg. water on the suction side of pump, the work done will be the same whether the pump is placed before or after the heater.

R. S. LANE,
Interborough Rapid Transit Co.
New York City.

A Question For Our Readers

WE PLAN to install unit pulverizers with our 3,000-sq.ft. boilers. It is necessary to carry a light load at night. Will this be possible with a single burner per boiler installation?

C. C. M.

Suitable answers from readers will be paid for and published in the October 15 issue.

ASSUMING that the feed water is heated from 100 to 300 deg. F. and fed to the boiler operating at 400 lb. gage, the pump will do more work when the heater is between the boiler and pump than when the pump is between the boiler and heater.

If h_1 is the head required for boiler pressure, line friction, velocity and elevation difference of pump and boiler drum; h_2 the pressure drop through the heater in feet of water, and h_3 the head on the suction side of the pump, then the work done by the boiler feed pump in foot-pounds when the heater is between the pump and the boiler is $[(h_1 + h_3) - h_3] \times$ the weight of the water delivered. The work done by the pump in foot-pounds when the pump is between the heater and the boiler is $(h_1 - h_2) \times$ the weight of the water delivered.

In the second case the head on the suction side of the pump must at least be equal to a pressure of 67 lb. absolute or the pump will become steambound.

Under usual operating conditions the head on the suction side of the pump in the first case would be approximately 10 ft. In this case the pump must also furnish the friction head loss through the heater.

Therefore, by observing the above equations, it is clearly seen that for an equal weight of water delivered, more work is done when the heater is between the boiler-feed pump and the boiler than when the pump is between the boiler and the heater.

JOHN BURT HAZLE,
Toledo Furnace Co.
Toledo, Ohio.

ASSUMING that the friction in the hydraulic circuit is the same whether the heater is installed on the suction or discharge side of the pump, the amount of work to be done and horsepower used will be the same in both cases.

If there is a 28-in. vacuum in the hotwell and the heater is installed on the suction side of the pump, the minimum distance the feed pump can be installed below the water level in the hotwell is 160 ft. to prevent flash in the pump. This would probably be impossible in the station layout. In case there is a hotwell pump with a discharge head of approximately 130 ft., it would be better to install the heater on the suction side of the boiler-feed pump. This heater could be designed for the lower pressure, which would be much cheaper than the high-pressure heater, which would be operating under full boiler pressure.

H. A. Goss,
Mechanical Engineer,
Sargent & Lundy.
Chicago, Ill.

IT WILL be observed that the several answers published are not consistent and, strange to say, some of the correct answers have been reached through devious processes of reasoning. Then, too, many readers answered by discussing questions other than the one asked.

If we consider the total horsepower required to lift the water from the condenser hotwell into the boiler, including the condensate and feed-pump power, more power will be needed if the feed pump is placed between the heater and boiler. This is because in the formula work-weight $\times$ head the head is not constant, depending upon the precise location of the heater. A more easily understood form of the same equation is work-pressure $\times$ volume.

As the volume increases with the increase in temperature, the total work of the boiler feed and condensate pump is greater when the feed pump is placed between the heater and the boiler, for this pump must handle a greater volume at 300 deg. than at 100 deg. F. In addition, the friction head is greater due to the increased velocity; this further increases the work. But as the boiler feed when handling 300 deg. water must have a suction head somewhat greater than 67 lb. absolute, the pressure corresponding to the temperature of 300 deg. F., the reduction in the head on the feed pump (415—67) lb. per sq. in. lowers the power needed to drive the feed pump more than the increase in the water volume, due to the 300 deg. temperature, increases the power.

The answer to the problem *asked* is that *less* power will be needed to drive the feed pump if the pump is placed between the heater and boiler.—L. H. M.

Recent Publications

Nouvelles Etudes sur le Chaleur (New Studies on Heat). By Charles Roszak and M. Veron. Published by Dunod, 92 rue Bonaparte, Paris, France, 1929. Paper, 6½ x 10 in.; illustrated, 752 pages. Price, 219 francs.

THIS work is an extensive mathematical treatise, in French, on heat, combustion, refrigeration and heat transfer. The authors, realizing that the theory and practice of heat application are today largely on an empirical basis, have here attempted to develop a rational scientific and mathematical treatment.

Following the theoretical part of the work, they deal in some detail with the applications of their theories. Heat exchangers, furnaces, boilers, boiler codes, central and district steam heating and other uses are treated from the technical, economic and financial standpoints. The book closes with a numerical example of the calculations for a heat exchanger.

A History of Mechanical Inventions. By Abbott Payson Usher, Associate Professor of Economics, Harvard University. Published by McGraw-Hill Book Company, Inc., New York, 1929. Cloth, 6 x 9 in., 410 pages; illustrated. Price, $5.

SEVERAL years ago, while engaged in some patent development work, the writer of this review acquired a profound respect for what is called the "prior art." It quickly became apparent that it is unwise to take any steps in connection with an invention without being thoroughly familiar with the history of previous work along the same line. It is hardly possible to proceed intelligently to perfect a patentable device unless one has this knowledge.

In the same way is a history of the development of machines important to the mechanical engineer or machine designer. One who comes fresh to such history is astounded by the fact that practically all conceivable devices have already been tried. This is so true that to-day most design work consists in improving upon the efforts of others, rather than in developing new mechanisms.

So it is that the engineer should welcome this work by Professor Usher. Starting with a discussion of the place of technology in economic history and the psychology of invention, the book treats interestingly of work done by inventors from the days of the early Greeks down to the present. Development of devices for power generation, of clock mechanisms and gear trains, and of machines for the printing, textile and metal-working industries receive particular attention.

Perhaps the most interesting part of the book for the average reader is the chapter devoted to the work of Leonardo Da Vinci. Few realize the influence of this remarkable genius on the development of mechanical devices. Some sixty-four major developments lie to his credit, in such diverse fields as hydraulics, military engineering, mechanics, machine tools, power machinery, textile machinery and aeronautics. Most of the work of recent mechanical inventors rests upon a foundation erected by this versatile artist and engineer.

European engineers have long recognized the value of the history of invention to inventors, and museums and books have been made available to meet the need. The United States has lagged. But Professor Usher's book is one of numerous signs that an awakening has occurred. It is a worthy effort that will unquestionably do much for the advancement of American technology.

Recent Economic Changes in the United States. Report of the Committee on Recent Economic Changes of the President's Conference on Unemployment. Published by McGraw-Hill Book Company, New York, 1929. Two volumes, cloth, 6x9 in., illustrated, 950 pages. Price, $7.50.

INFORMED leadership is necessary to the continuation of our prosperity. That is the principal thought that one carries away from a perusal of this report, made by a committee appointed by President Coolidge, under the chairmanship of Herbert Hoover and completed under the acting chairmanship of A. W. Shaw, in the first months of President Hoover's administration.

The report is made under the following heads: Consumption and the Standard of Living. Industry; Part 1, Changes in New and Old Industries; Part II, Technical Changes in Manufacturing Industries; Part III, The Changing Structure of Industry. Construction. Transportation. Marketing. Labor. Management. Agriculture. Price Movements and Related Industrial Changes. Money and Credit and Their Effect on Business. Foreign Markets and Foreign Credits. The National Income and Its Distribution.

The authors of these sections were chosen from among such leaders of American thought as Dexter S. Kimball, Edwin F. Gay, Melvin T. Copeland and Henry S. Dennison. Their own efforts were supplemented by special studies made under the direction of the National Bureau of Economic Research and by information supplied by a host of others, including universities, foundations, corporations and individuals.

Among the general conclusions reached by the committee are that at the head of this review and that which found that no fundamental changes had occurred to account for present conditions, but rather a speeding up of the whole "tempo" of American life.

Increased availability and use of power come in for a large share of the credit for present prosperity. It is pointed out that the per capita wealth in the United States bears the same relation to the per capita wealth in Great Britain as the total per capita horsepower here does to the total per capita horsepower there.

All in all, this report serves to bring into focus the enormous developments that have occurred in the industry of this country during the years which it covers, 1922 to 1929. In spite of this, however, it makes evident that the United States has as yet only scratched the surface of its industrial possibilities. The committee is convinced that "economically, we have a boundless field ahead of us." That remark is a sample of the tone of much of the work, but the facts brought out seem to justify it.

In addition to being interesting and profitable reading, these volumes shou'd serve as a splendid reference book for many years to come.

Introduction a l'Etude de la Physique Théorique (Introduction to the Study of Theoretical Physics). Part IV, Electricity and Magnetism. By René Fortrat. Published by Libraire Scientifique Hermann & Cie, Paris, 1929. Paper; 180 pages; illustrated. Price, 10 francs.

THIS work is a textbook for students of electricity. It is in French and therefore not suitable for use in American practice. However, for those who read the language and can comprehend the mathematical treatment employed by the author, it is a brief and clear exposition of the subject.

Industrials—Their Securities and Organization. By Sterling H. Bunnell. Published by A. W. Shaw Company Book Division, a Subsidiary of the McGraw-Hill Book Company, Chicago, 1929. Cloth, 5½ x 8½ in.; illustrated, 334 pages. Price, $5.

IN THESE days everybody is interested in the buying and selling of stocks and other securities. Gradually, as a result of this, ownership of the great industrial concerns of the country is passing into the hands of the general public. Often this is profitable to the new owners; but some companies are not a safe place for the small investors' money. How shall he discriminate? What yardstick shall he use to measure the possibilities of an industrial security?

Mr. Bunnell has written a book that should be of distinct service to many investors and prospective investors. It discusses at some length the organization, purpose, financing, management and other important factors in the success of a manufacturing undertaking. These are summed up in a final chapter which gives a procedure for investigating an industrial company and using the information so obtained for determining the standing of its securities.

New Non-Destructive Tests Revealed at Fall Meeting of American Welding Society

Session in Cleveland Notable Also for Variety of Research Papers, Report on Boiler Welding Abroad, and National Metal Exposition

FROM the point of view of general interest, as well as the future development of the welding industry, the outstanding feature of the fall meeting of the American Welding Society, held last week in Cleveland, was the revelation of new non-destructive tests of welds. In all, sixteen technical papers were presented in six technical sessions covering the period from Sept. 10 to Sept. 13, inclusive. About 300 members of the welding society attended.

Morning technical sessions were held in the Hotel Statler, and afternoon sessions at the Public Auditorium, where the immense National Metal Exposition was in progress under the joint auspices of the American Welding Society and the Society for Heat Treating. With this exposition as a background, Cleveland last week was the Mecca of metal specialists, technical meetings being held not only by the American Welding Society and the American Society for Steel Treating, but by the Iron and Steel Division of the American Institute of Mining Engineers, the Institute of Metals Division of the American Institute of Mining Engineers, and the Iron and Steel Division of the A.S.M.E. One technical session (Thursday afternoon) was sponsored jointly by the American Welding Society and the American Society of Mechanical Engineers.

The welding society program was notable for the extent of research and testing activities covered. Of the papers presented, more than half represented the results of some form of laboratory work, with testing occupying a prominent position.

Elmer Sperry, well known inventor and a past president of the American Society of Mechanical Engineers, was the author of one of the papers on non-destructive tests, the other being presented by A. B. Kinzel, C. O. Burgess and A. R. Lytle, all of the Union Carbide & Carbon research laboratory. (Abstracts of these papers appear immediately after this report.)

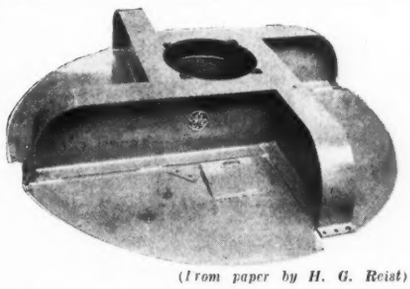
Two papers presented at the first technical session, on Tuesday morning, dealt with the use of welding and cutting in machine manufacture. H. G. Reist, of the General Electric Company, in a paper on the effect of design on the use of welding in the manufacture of electric machinery, stressed the importance of designers of welded machines forgetting preconceived notions of shape and proportion based on experience of past construction. He showed pictures of large generators, machine foundations and similar structures fabricated by welding by General Electric Company.

In a paper entitled "Cutting and Welding Steel Parts to Replace Castings" W. S. Buchanan, of the Bessemer Gas Engine Company, announced that great savings had been made in his plant by the extensive use of oxygen shape-cutting machines to produce parts of Diesel engines.

"At the present time," he said, "we have over 50 jobs listed as regular production work to be handled by the shape cutters, and these are only a start. Before another year is over they should jump to 150 or more. Every day we are finding new work that can be done more quickly and more cheaply by the shape-cutting machine than by any other method."

Special difficulties in the welding of copper and high copper alloys, their causes and the methods of overcoming them, were discussed in detail by Ira T. Hook, testing engineer, of the American Brass Company. Oxidation at high temperatures, high heat conductivity and other special properties of copper, Mr. Hook pointed out, make its welding a matter requiring judgment and skill.

"How to Test Welds" was the subject of a paper on Tuesday afternoon by F. G. Tatnall, of the Southwark Foundry & Machine Company. Mr. Tatnall explained particularly the instruments



(From paper by H. G. Reist)

Swastika design of upper bearing bracket of hydraulic turbine-generator

useful in weld testing. These include tensile test machines, the bend test extensometer, strain gages, the 40,000-ton portable tensile-testing machine, strain-gaging equipment with electrical connections, resistance type of strain gage, etc. The portable testing machine, developed by A. B. Kinzel, of the Union Carbide & Carbon research laboratories, resembles a small oxygen gas cylinder in shape, size and weight. It is entirely self-contained, with built-in pump. Load readings are taken on a dial gage.

A technical session on Wednesday afternoon was devoted to papers dealing with welding from the angle of the chemist and the metallurgist. D. Alexander, of the General Electric Company, gave a preliminary report of an investigation that seemed to prove that the so-called nitride needles found in some welds are actually oxide. Current misconceptions about carbon arc welding were upset by G. E. Doan and E. Ekholm, of Lehigh University. It has been commonly thought that the carbon arc would invariably increase the carbon content of the material in the weld. The chemical studies of Messrs. Doan and Ekholm show that the contrary is generally the case. There appears to be a certain minimum arc length for each current density beyond which no increase in carbon content results from welding.

Metallic arc welds were represented by Prof. H. M. Boylston (Case), who presented the results of a metallographic study.

Major J. B. Rose, Ordnance Department, United States Army, in presenting a paper entitled "Welding Studies at the Watertown Arsensal" gave much attention to the results of X-ray tests. The Watertown Arsenal has for a number of years used X rays in the inspection of steel parts and structures.

A paper dealing with stresses in fillet welds, such as are used mainly in structural work, was presented by Prof. J. A. Smith, of the University of Pittsburgh.

The joint session with the Iron and Steel Division of the A.S.M.E. on Thursday afternoon was given over to three papers, that by Elmer Sperry, already mentioned; a paper by George J. Orrok, consulting engineer, on foreign practice in welding of boiler tubes and drums; and one on automatic arc welding of thin sheets by W. L. Warner, of the General Electric Company.

Mr. Orrok's paper, which will be published in an early number of *Power*, showed that boiler welding is extensively used in Europe, where the code regulations in this matter are less restrictive than in the United States, and that the results obtained have been satisfactory not only to the manufacturers but to the users of boilers. He concluded, "It would appear that our boiler codes need modification in such fashion as to allow the use of the three latter forms of welding [electric welds, oxy-acetylene and thermit] under proper safeguards."

In a paper presented at the Friday morning session W. R. Ost, of the Air Reduction Sales Company, gave the practical details of laying welded pipe lines in open country, using for illustration a 45-mile pipe connecting two cities in the Mid-West. On this work finished pipes in 40-ft. lengths were welded by the oxy-acetylene process at the rate of one mile per day by fourteen welders.

The latest procedure, according to Mr. Ost, is to join the pipe sections by tack welds in the field in sections from 200

to 400 ft. long. These sections are then welded into one piece by gangs of welders working simultaneously as the section is rolled by laborers, using a turning lever or chain tong. The welding of these pipe sections is always done on the surface of the ground. The welded sections are then joined into one continuous pipe by bell-hole welds before being lowered into the trench.

The electric welding of field joints of oil and gas pipe lines was similarly dealt with by H. C. Price, of the Welding Engineering Company, while H. A. Wooster, of the Swift Electric Welder Company, presented a paper on the welding of tubing and pipes for locomotives and boilers.

In addition to these regular technical sessions a special conference of research workers on the fundamentals of welding was held on Wednesday morning. A meeting of the Structural Steel Welding Committee was held on Wednesday evening. The American Bureau of Welding held its meeting on Friday afternoon.

Special features and entertainment included an inspection tour Wednesday morning, the annual banquet and dance of the American Welding Society on Thursday evening, and special luncheons and lectures for the ladies.

Following are abstracts of the papers on non-destructive tests presented by Mr. Sperry and by Messrs. Burgess, Kinzel and Lytle

Automatic Non-Destructive Weld Tester Examines 20,000 Rails a Day

THE tremendous growth of the welding industry has taken place in the face of one great obstacle—the need for a test that would prove the internal soundness of a weld without destroying the joint in the testing process. This need has now been met by an extension of a method developed by the writer for the testing of railroad rails (in place) for internal fissures. Disastrous train wrecks, due to these invisible cracks, led the rail committee of the American Railway Engineering Association to ask the writer, in 1926, to adapt his electrical method of inspection to the location of internal transverse fissures in tracks. Up to that time nothing but the sudden failure of the rail in service would reveal their presence.

The Sperry rail tester is housed in a car that proceeds along the track at a fair speed. By purely electrical means it plots continuous curves on paper, giving a precise picture of the internal uniformity of the rail, inch by inch, so that the location and extent of flaws are precisely indicated. More than that, the flaws are automatically "tagged" by the spraying of paint on each defective point in the rail as the car passes along. At the present time cars of this type are examining 20,000 rails per day.

In theory and in operation the testing device is as simple as it is effective. An electric current is passed along the rail between two brushes, this current being supplied by a gasoline engine-driven generator on the car.

Between the two main brushes are three pick-up brushes equally spaced. Current flowing from the first to the second passes through a transformer coil, while that flowing from the second to the third passes through a similar coil wound in opposite direction on the same core. If the rail is uniform equal current passes through both coils, each neutralizing the magnetic effects of the other.

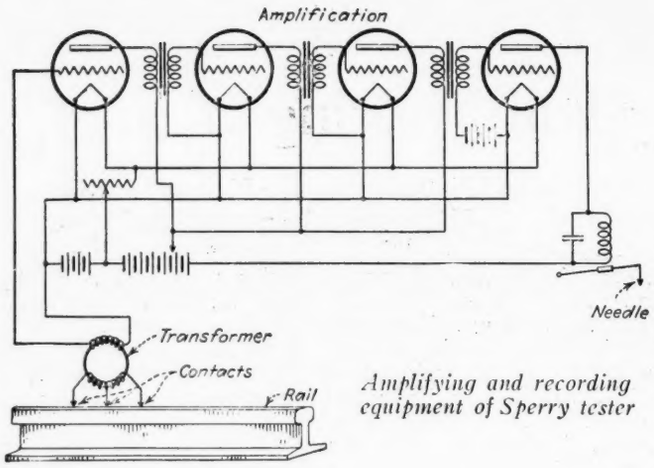
If, however, a section with a fissure passes between the first two brushes, the added resistance in the rail charges the current flow in that section, so that the two coils no longer balance each other. The result is a magnetic "kick" in the core, followed immediately by a "kick" in the other direction as the car moves to straddle the defect with the second and third brushes. This back-and-forth surge is picked up by the secondary of the transformer, and amplified by several stages of radio tubes, until it can operate the recording pens and the paint-spraying device.

It is obvious that this principle can be applied to the testing of welds in bars, plates and rods of uniform section, since any hidden defects in the welds will increase the local resistance to the flow of current and deflect the needles.

The initial work on the testing of welds by the electric method was performed on welds joining ½-in. cold-rolled plates. Both gas and electric welds were tried, each sample containing a hidden defective spot. An adaptation of the standard test method was quickly developed which made possible the accurate location of the defects. This method is not only applicable to welded plates, but may be used for the inspection of welded drums, pipes, etc.

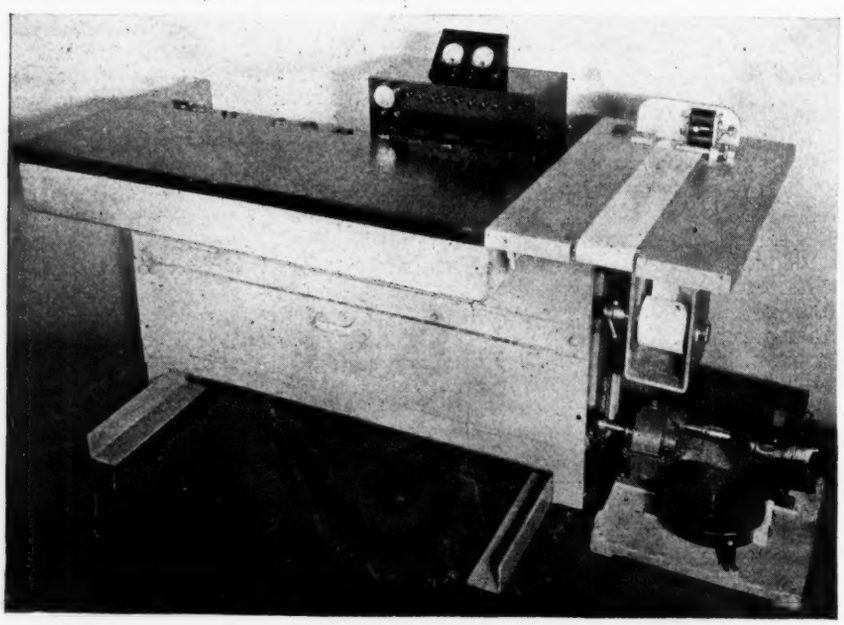
The application of this method of inspection to welded structural steel buildings or welded steel ships involves a small plant, which, in point of size, is on the order of a 5-kw. welding set.

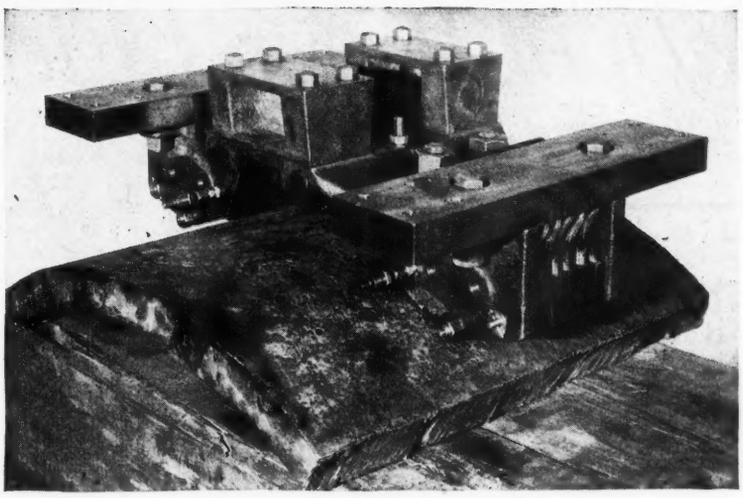
A plant has been constructed for testing welded joints of plates up to between 3 and 4 in. in thickness, and forming drums of different diameters. The inspection to date is found to be accurate and dependable. It goes forward at a rapid pace and gives an ink record



Amplifying and recording equipment of Sperry tester

Diagram of circuits used in Sperry rail tester





Brush rigging for application of Sperry test to welded drum

which is in the nature of a certificate of complete soundness of the weld. This apparatus is capable of adjustment to record minute defects, or it will record only those exceeding a certain predetermined area or percentage of a unit length of weld equal to the plate thickness.

Welds in different structural shapes have been brought under the electrical inspection. It is found that some require special shapes of the inspection element, which is a light affair, weighing about a pound.

It would thus seem that the time is close at hand, if it has not already arrived, when by a simple combination of a well-known group of scientific facts and elements we are able to ascertain the internal structure throughout any weld or any critical part thereof, thereby finally establishing its complete integrity and freedom from hidden flaws of any type, establishing it as a 100 per cent union throughout its entire length longitudinally.

Non-Destructive Tests of Welds With X Ray and Stethoscope

Abstract of paper by A. B. Kinzel, C. O. Burgess and A. R. Lytle, all of the Union Carbide & Carbon Research Laboratory.

IN the normal course of events the reliability of fusion welding will undoubtedly be accepted in much the same way as riveting is accepted today. Without non-destructive testing, this would, of course, take considerable time. It would mean that sufficient actual experience would have to be obtained to remove all doubt from the minds of even the most skeptical that the probability of weld failure in important work is negligible.

The authors have devised and developed methods of non-destructive testing of welds applicable to plates, pressure vessels, pipe joints and structural steel joints. The method consists essentially of first detecting by means of a stethoscope the presence of any spots in the weld that are different in character from the satisfactory weld, and, second, in obtaining special X-ray photographs of these spots, to determine the seriousness of the deviation from normal.

The village blacksmith hammers metal cold on the anvil to test it by the ring. In sounding a tank, however, there are a great many difficulties to be encountered through the forced and natural vibrations of the tank and the tendency for the natural vibration to drown out all other sounds.

The authors have used the stethoscope to overcome these difficulties. The instrument consists of the ordinary physician's apparatus with a gum rubber tip.

The drum, pipe or plate in question is struck with a small hammer at the spot to be tested. The weight of the hammer and force of the blow depend upon the thickness of the plate, and the stethoscope is applied to the tank in the general vicinity of the striking zone. The sound heard at the instant of first tapping the joint is critical and is a function of the character of the material at the spot struck.

Each welded structure has a characteristic sound. After this is determined by brief preliminary tests, the hammer and stethoscope are moved along the weld, so that any irregularities are discernible.

The method has been applied to welds in pipes and pressure vessels, to a number of specially made welds in plates and to welded structural steel joints. The latter were made with intentional defects unknown to the authors and in each case the location of the defect was correctly determined by the use of the stethoscope.

X-ray examination as arranged by the authors may be used in conjunction with a stethoscope or as an independent sampling method. In the past most of the X-ray work on welds consisted in taking pictures directly through the weld, the Xrays passing in a line normal to the plane of the plate. As a result, some idea of the porosity is noted, but the lack of fusion on the scarf in V-welds is not clearly registered on the film. By taking two photographs parallel to the respective scarfs, this difficulty is eliminated. From the appearance of the film and a knowledge of the plate metal and welding rod used, the ultimate strength of the weld may be estimated with considerable accuracy after a little experience.

Testing weld with hammer and stethoscope

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

*Spot * News*

CITIZENS OF MAINE *opposed to the export of hydro-electric power from the State won a decisive victory at the referendum held on Sept. 9, when the Smith-Carlton bill was defeated by a large majority. This marks the end of one of the bitterest power fights ever waged in the country.*

* * *

NEW ORDERS *for 2,052 steel boilers were placed in July, as reported to the Department of Commerce by 80 manufacturers comprising most of the leading firms in the industry, as compared with 1,685 boilers in June and 1,932 in July, 1928.*

* * *

SECRETARY DAVIS, *of the Department of Labor, has consented to speak at the banquet on October 8, held in connection with the Third National Fuels Meeting in Philadelphia, October 7 to 11, at the Bellevue-Stratford Hotel, according to an announcement of the program committee.*

* * *

COMPLETION *of the second 50,000-kw. turbine-generator unit took place recently at the Delray power house of the Detroit Edison Company. Three boilers and two units are now in operation in the new plant, with a fourth boiler scheduled for completion Oct. 15.*

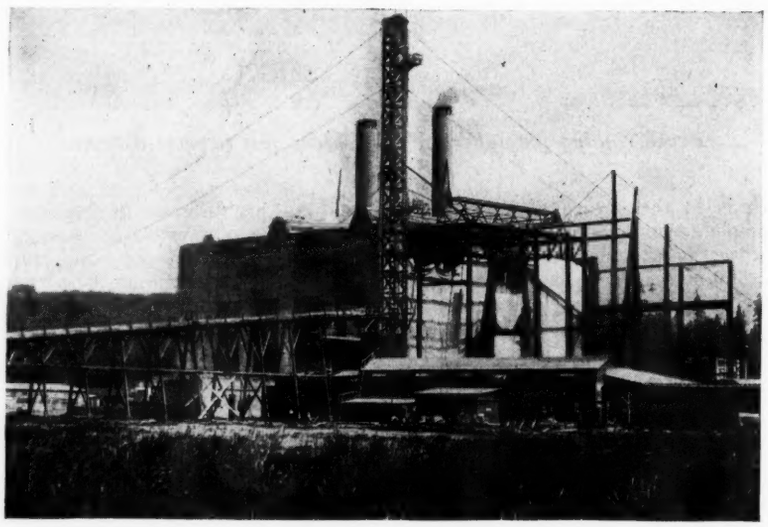
* * *

NOTICES *have been sent out to prospective purchasers of power to be generated at Boulder Dam that their applications for such power must be filed with the Department of the Interior in Washington not later than Oct. 1, it was announced Sept. 10.*

* * *

AERIAL PHOTOGRAPHY *has brought to light a power site of more than 20,000 hp. in southeastern Alaska, according to a recent message received by the Department of Agriculture. It is expected this unique use of aviation will become increasingly valuable in the development of power in out-of-the-way places.*

Completion of Shuffleton Plant Adds 50,000 hp. to Puget Sound System



ADDING 50,000 hp. to the electric system of Puget Sound Power & Light Company, Seattle, Wash., the first unit of the Shuffleton steam plant was completed recently. The new plant is located at the south end of Lake Washington, near Renton, Wash. Through a decision of the company made last spring work has already been started on the construction of a second unit, which will bring the ultimate capacity of the plant up to 100,000 hp. The whole project involves an expenditure of $7,000,000.

Outstanding features of the new steam plant are its generator unit and boilers. These are said to be the largest ever installed in the State of Washington. The boilers will be oil fired, with complete automatic combustion control.

The following description of the plant is taken from an article in the August issue of the *Puget Sound Electric Journal:*

The lowest floor of the power house contains the various pumps used to handle the condenser water, the raw water, and the condensate from the turbine. In connection with the condenser water, it may be here mentioned that a tunnel of 54 sq.ft. area was driven from the lake to the power house. This tunnel has at its outer entrance a set of rack bars and revolving screens which clean any floating débris from the water and put clear fresh water from Lake Washington into the condenser pumps.

The main floor of the turbine room houses various equipment in connection with the main generator, such as the generator switch and the field controls. The foundations of the turbine and generator are 32 ft. high, reaching up to the next, or turbine, floor.

In the auxiliary bay of the building is a miscellaneous lot of equipment, such as the high-pressure boiler-feed pumps, one of which is run by a steam turbine, and the other two by motors; a battery of evaporators, an air compressor, the turbine oil storage and filtering apparatus, and a miscellaneous lot of small pumps.

The main unit is a 17-stage steam turbine, revolving at 1,800 r.p.m. and capable of turning out 50,000 hp. at 13,000 volts. Adjacent to the main turbine is a house generator set of 2,500 kw.

To the north of the auxiliary bay on the main floor are the foundations for two of the largest boilers ever erected in the State of Washington. These two boilers are of the Stirling type, and will supply steam at 450 lb. pressure and 750 deg. superheat. They are provided with automatic combustion control. A battery of sixteen oil burners is built into the front face of each furnace. Provision is made for the storage of 80,000 gal. of oil.

Power from this plant will be delivered at a load center to be constructed on the company's high tension transmission system where the largest switching station in the Northwest is to be constructed and into which will be directed the power output of all the major hydro-electric and steam generating plans for distribution to points of demand.

Tokio Congress Delegates and Papers Announced

The official list of delegates chosen by the scientific and technical societies and engineering educational institutions of this country to represent them at the coming World Engineering Congress in Tokio has just been issued by Maurice Holland, executive secretary of the American committee of the congress and director of the Division of Engineering and Industrial Research of the National Research Council.

The delegates include:

M. W. Alexander
H. Foster Bain
George D. Barron
Edward Bartow
F. W. Bradley
George K. Burgess
Howard E. Coffin
W. H. Carrier
George S. Davison
John V. N. Dorr
Byron E. Eldred
John R. Freeman
E. H. Fritch
George W. Fuller
Mrs. L. M. Gilberth
C. E. Grunsky
Allen Hazen
H. D. Hibbard
Maurice Holland
John C. Hoyt
F. L. Hutchinson
James E. Ives
D. C. Jackson
F. B. Jewett
Lieut.-Gen Edgar Jadwin
C. M. Keys
C. W. Latimer
C. K. Leith
Wilfred Lewis
Paul M. Lincoln
Francis F. Lucas
Charles T. Main
R. R. Martel
E. C. Martin
Charles D. Marx
W. B. Mayo
C. W. Merrill
O. C. Merrill
Ralph Modjeski
L. A. Osborne
H. de B. Parsons
Asa E. Phillips
Donald B. Prentice
Antonin Raymond
Henry G. Reist
Mark L. Requa
J. V. W. Reynders
Calvin W. Rice
Robert H. Richards
Joseph W. Roe
David Rushmore
Herman Schneider
R. F. Schuchardt
C. E. Skinner
George Otis Smith
Elmer A. Sperry
Francis Lee Stuart
A. N. Talbot
Max Toltz
E. N. Trump
Daniel L. Turner
H. Bruce Walker
W. Y. Westervelt
F. C. Hanker
Charles W. Stone
William Elmer

Among the foreign delegates who are visiting the United States en route to Tokio are:

From Germany—Carl Koettgen, Oberbaurat Helmle, Adolpf Krauss, C. Matschoss, Graf Vitzthum, Otto Petersen, Ministerialrat Kralik, Bergrat Tuebben, Professor Probst, Emil Hayn, Charles Gorrissen, Max Eduard Hasche, Oskar von Miller, K. W. Wagner, Mr. Fiebiger, Mr. Buchholz, Mr. Lindhagen.

From England—Richard W. Allen, Lieut-Col. A. H. S. Evans, Ernest F. C. Trench, Sir Alexander Gibb, F. Wakeham, Allen West, Frank Gill and Fay Rosencrants.

From Sweden—Axel F. Enström, Mr. Weibull.

From Jugoslavia—R. M. Aranovitch.

From Italy—Luigi Luiggi.

From France—Colonel Pernod.

From Denmark—Mr. Thomsen.

Among the papers to be given by American engineers before the congress are:

"Remote Operating Supervision and Control of Electric Power Stations and Substations," Chester Lichtenberg and F. Zogbaum.

"American Developments in Diesel Engines," L. H. Morrison and Edgar J. Kates.

"American Power Station Electrical Equipment," F. D. Newbury.

"Economics of Water Vs. Steam Power," G. A. Orrok.

"Standardization," C. E. Skinner.

"Recognition of the Engineer and the American Engineering Societies," Elmer A. Sperry.

"Operation of Turbine-Generators on a Total-Temperature Rather Than on a Temperature-Rise Basis," Philip Torchio, W. J. Foster and F. D. Newbury.

"Industrial Progress Made Through Research and Its Economic Importance," Willis R. Whitney.

"Engineering Education in America," W. E. Wickenden.

"International Co-operation of Engineers," John Hays Hammond.

"Safety in Dam Construction," Allen Hazen.

Several luncheons and dinners form part of the program of entertainment for the foreign delegates en route to the World Engineering Congress in Japan. A number of these delegates are already in New York and more are expected within the next few days.

Last Thursday evening a dinner in honor of Dr. Carl Koettgen, President of the Verein Deutscher Ingenieure and delegates to the World Engineering Congress was held at the Engineers Club, New York, with an attendance of about seventy.

Dr. Elmer A. Sperry, President of the American Society of Mechanical Engineers acted as toastmaster and graciously paid a tribute to the engineering progress of the Japanese. Addresses were made by Dr. Koettgen and Dr. Matschoss, both of Germany, and by Major H. C. E. Cherry of England.

Dr. Koettgen, who is also Managing Director of the Siemens Schuckert Works, reviewed the influence on human progress of the four principal branches of engineering in the order in which they made their appearance, namely, mining, civil, mechanical and electrical. Dr. Matschoss touched upon the work of some of the earlier pioneers in engineering and paid a tribute to President and Mrs. Hoover for translating the first book on mining engineering, "De Re Metallica," which was a product of a German engineer and which served as the ground work for subsequent mining engineering in practically every country in the world.

Major Cherry gave a picture of the life in Burma and told of some of the problems encountered by the Public Works Department there.

Steam Spouts High As Main Bursts

STEAM shot up 150 ft. in the air through manholes and breaks in the pavement when a sixteen-inch steam main burst near Lexington Ave. and 57th St., New York City, at 11 p.m., Sept. 8. For over an hour a considerable area in the vicinity was subjected to a violent steam storm accompanied by a shower of asbestos flakes from pipe coverings thrown up by the geyser. Traffic was fogbound by the vapor, and people living in the district were forced to close the windows of their residences. No injuries were reported.

Emergency crews worked for some time to locate the valve that would cut out the damaged steam line, which belonged to the New York Steam Corporation's system. For a while it looked as if the fires in the company's boiler plant at First Ave. and 59th St. would have to be pulled in order to reduce the pressure in the main. Finally, however, an emergency gate was found that stemmed the flow, and one of New York's most spectacular accidents was over.

Plans Formulated for National Power Show

Plans are well under way for the eighth National Exposition of Power and Mechanical Engineering at Grand Central Palace, New York City, opening Dec. 2, and continuing throughout the week.

The National Power Show has become a national institution since its inception in 1922, when the attendance was only 47,589. Last year's attendance was 123,000, and the number of exhibitors made the phenomenal showing of 542, against only 105 in the first year of the exposition. This growth, it is pointed out, is due largely to the fact that the exposition covers the entire field of power generation and mechanical engineering. It represents a nation-wide gathering of exhibitors, carrying a complete collection of machinery and products intimately related to the subject.

From a list of over 400 corporations that have already reserved space, this year's exhibits may well be grouped into three general classes: first, new developments, comprising new inventions, new processes and new ideas; second, improvements on old principles; and third, those grouped under engineering staples. Producer and consumer will meet under unique conditions to see, to compare and to understand the different products and processes. The show will disseminate knowledge of mechanical advancement for the benefit and inspiration of those inside and outside of the engineering profession.

The advisory committee of the National Power Show is made up of the following well-known engineers: I. E. Moultrop, chairman, Edison Electric Illumination Company, Boston; Homer Addams, past president, A. S. H. & V. E.; A. Black, chairman, professional divisions, A.S.M.E.; N. A. Carle, general manager, Pacific Electric & Manufacturing Company; Fred Felderman, past national president, National Association of Stationary Engineers; F. M. Gibson, chairman, power division, A.S.M.E.; C. F. Hirshfeld, chief of research department, Detroit Edison Company; O. P. Hood, chief mechanical engineer, United States Bureau of Mines; John H. Lawrence, Thomas E. Murray, Inc.; Thornton Lewis, president, A. S. H. & V. E.; Fred R. Low, past president, A.S.M.E.; David Moffatt Myers, consulting engineer; M. S. Sloan, president, N.E.L.A.; Arthur J. Wood, president, A.S.R.E.. Fred W. Payne and Charles F. Roth, with offices in Grand Central Palace, New York, will manage the show.

First Unit of Riverbend Plant Completed

The first unit of the steam-electric plant of the Duke Power Company now under construction at Riverbend, near Mount Holly, N. C., will be placed in operation about Sept. 20, it is reported at the company's headquarters at Charlotte, N. C. This project, involving expenditures aggregating several millions of dollars, is in an advanced stage.

Completion of the plant, which will operate with coal as fuel, will add approximately 110,000 kw. to the available supply of the Duke company. The generating equipment of the first unit will include two steam-turbine generators, each with a capacity of 55,000 kw. The turbines are designed for four-stage heating of feed water. Steam will be generated in four boilers at a pressure of 400 lb. per sq.in. and a total temperature of 725 deg. F. The boilers will be fired by a unit system of pulverized fuel. Space has been provided for the storage of 100,000 tons of coal at the plant.

In addition to constructing the large power house, the company had a canal and tunnel dug across the land around which the Catawba River bends, which gave the plant its name of Riverbend. Through this combination of canal and tunnel will be diverted a large part of the normal flow of the river to provide water for use in the condensers.

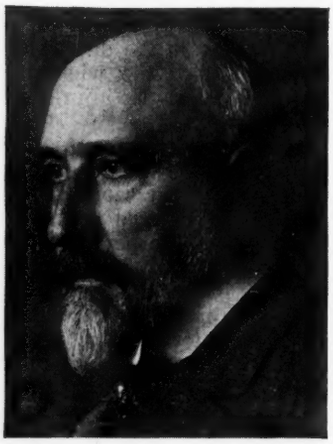
Plans of the power company provide for this plant to be in constant operation as a base-load plant after it is completed. The plant, as now being constructed, is the first of several units which it is proposed to be built there as the demands for power produced by this company increase. The ultimate capacity of the plant will be 440,000 kw.

Dr. Koettgen Speaks on Second Power Conference at Dinner in His Honor

Prosperity in the United States may be traced in large measure to the high state of development and use of our power resources, Dr. Carl Koettgen, president of the German national committee of the Second World Power Conference, to be held in Berlin in 1930, told a group of industrialists and engineers assembled in his honor at the University Club on Sept. 11. As the United States uses more power per working person than any other nation in the world, Dr. Koettgen said, it was hoped that America's contribution to the forthcoming conference would emphasize the adaptability of this broad use of power for the general benefit of mankind.

Specifically, the objectives of the forthcoming World Power Conference may be summarized as follows, Dr. Koettgen said: From the point of view of the power engineer, the minimum waste of power, the most reliable methods for its utilization, the broadest field of application; for the power economist, the opening of new markets for power, the improvement of such markets to provide a profitable field for investment; wise legislation, the protection of health, and the more extended use of power, are the aims of power administration; and from the viewpoint of education, to make mankind of today the wise ruler of his soulless servant, to fuse technical and human education into one harmonious whole.

Dr. Koettgen, who is president of the German Society of Engineers, arrived in New York Sept. 10 aboard the "Bremen." As one of Germany's official delegates he is on his way to Tokio for the World Engineering Congress. The dinner in his honor was given by the American committee of the World Power Conference and was attended by executives and engineers of the power industries, representatives of the German Embassy and men in public life. O. C. Merrill, recently of the Federal Power Commission and chairman of the American committee, presided. Other speakers at the dinner were Dr. Conrad Matchoss, secretary of the Berlin World Power Conference; S. R. Inch, vice-president of the Electric Bond & Share Company; and E. M. Herr, of the Westinghouse Electric & Manufacturing Company.



Carl Koettgen

Sydney, Australia, Develops Large Steam Plant

The growth of the Sydney, Australia, City Council electric power undertaking has been phenomenal, and now it ranks as one of the largest in the world. Expenditure on the system to date is $67,500,000, while it is estimated that a further outlay of at least $25,000,000 will be necessary before the end of 1935 if the system is to keep pace with the growth and demand for electric energy. The city commissioners have authorized an extension to the Bunnerong power house which is to be commenced at once. Tenders are to be invited for the erection of the additional bay, and plant will be ordered for delivery as soon as the building is ready for its installation.

There are now installed at Bunnerong eighteen boilers, each capable of evaporating 12,000 gal. of water per hour. These supply steam for six turbine-alternators, each capable of continuously generating 25,000 kw. No additional boilers are included in the recently approved extension. There will be sufficient steam from the present plant for the 25,000-kw. turbine-alternators, which, it is anticipated, will meet developments for the next two years. But by the winter of 1933 the general manager of the Sydney Electricity Department (Forbes McKay) considers that portion at least of the third section of the Bunnerong Power House should be ready for the supply of current. This third section is being planned on a scale believed sufficient to meet the developments that will take place in the use of electricity for all purposes during the next three years. The boilers will be much larger than those already installed at Bunnerong. There will probably be six of them, each rated to evaporate 25,000 gal. of water per hour. These will drive two large turbine-generators rated at 50,000 kw. each.

Good Gives Views on Power Commission

So important are the problems coming before the Federal Power Commission, said James W. Good, Secretary of War, Sept. 4, that Congress will be obliged in the near future to set up an organization that is not only impressed by the responsibility incurred in administration of the Federal Water Power Act but which has the time to devote to the increasing amount of work involved. "I am sure," said Secretary Good, "that some action of that sort will be necessary. The three members of the cabinet now making up the commission cannot give the time to it that the importance of the matter demands."

Secretary Good said that as an individual member of the commission he had no objection to the fullest investigation by Congress, such as that proposed by Senator Couzens, concerning the commission's activities. In view of the controversy that has arisen concerning the commission's procedure, said Secretary Good, such an investigation might lead to a better administration of the law.

"The members of the commission can give very little time to it, and it would be a good thing for the executives in charge to know that Congress is interested."

With reference to relieving the cabinet members of their duties as members of the commission by the creation, presumably, of an independent organization, Secretary Good said that approving applications for licenses is "a pretty big problem to deal with." In predicting that its importance will actuate Congress to create a permanent organization, Mr. Good explained that he was expressing his own personal views and was not speaking for the commission.

Edison to Celebrate Golden Jubilee at Dearborn

Plans have been announced to re-enact the scene of Thomas A. Edison's first demonstration of the incandescent light, on the occasion of the fiftieth anniversary of the event, at Dearborn, Mich., Oct. 21, according to the *Ford News*.

The laboratory in which Mr. Edison and his associates perfected and demonstrated the light has been transplanted, with all its accessories, to the museum grounds of the company, at Dearborn. The original power plant used by Mr. Edison will be installed, and the great inventor will throw the switch which will send current through the same lamp he used on the evening of Oct. 21, 1879.

Several of the men who were associated with the inventor in the task of discovering the method of light which has come to be a common necessity of the world will be present to assist and take part in the celebration.

Noted scientists and other distinguished persons will be invited by Mr. Ford to come to Detroit "to honor Edison, the man." A part of the program of the day will be a ride from Detroit to Dearborn on a train identical in make-up with that on which Mr. Edison rode in his youth as news-and-candy vendor, with his own laboratory and a small hand-printing press in the combination baggage and mail car.

The occasion of Mr. Edison's being thrown out of the car with all his belongings at Smith Creek Station, near Port Huron, when one of his experiments exploded and set fire to the contents of the car, will be humorously recalled when this anniversary train pulls up beside this same station building, recently purchased by Mr. Ford and moved to the museum grounds at Dearborn.

Stewart Advocates Uniform Certificate for Canada

By Campbell Bradshaw

Declaring the greatest need of the 1,500 engineers, of all classes, in Manitoba's power plant field, to be interprovincial certificates, R. A. Stewart, chief boiler inspector of the province since 1916, informs *Power* that in his opinion an educational campaign must be waged continually to get engineers to keep up to date on new developments.

Mr. Stewart reports both boiler construction and inspection regulations are working exceptionally well in the 400 plants within his jurisdiction, and attributes the satisfaction voiced by both owner and operator to the fact that, unlike Ontario and some of the other provinces, one department has control of both the construction and annual inspection of boilers in Manitoba. He is a pioneer advocate of Canada's interprovincial regulations for the construction of steam boilers, and sponsors similar certificates for operators, indeed, regards it as a necessity. He cannot see why an engineer who has obtained a license in one province should not be allowed to operate in another. This lack of accord, he feels, has been a serious detriment to the progress of power plant engineers.

Elected worthy chief for 1929 of Winnipeg No. 44 Universal Craftsmen's Council of Engineers, a branch of the widely known United States organization, Mr. Stewart holds first-class certificates in three provinces—Manitoba, Alberta and Saskatchewan.

R. A. Stewart

In 1918 he took a leading part in the conference at Winnipeg, which finally resulted in the passage of the interprovincial regulations for the construction of steam boilers and pressure vessels. He is a member of the A.S.M.E. and a consistent believer in the technical publication as the best source of information for engineers who want to keep posted on the new developments in their fields.

Manitoba's Regulations

The rules and regulations, showing the necessary qualifications for applicants for operating certificates in Manitoba, follow:

No person shall be eligible for examination as an engineer in Manitoba, unless he is a British subject, or has resided in Canada for at least one year immediately preceding the date of application, and is of the full age of 21 years; provided further that:

1. An applicant for a third-class certificate shall have served at least two years firing a steam boiler or boilers; or shall have served at least two years on the work of building or repairing steam engines or boilers, together with six months firing a steam boiler, or shall have had such other practical experience as qualifies him for examination.

2. An applicant for a second-class certificate, in addition to qualifications required for a third-class certificate, shall have served at least one year assisting an engineer in charge of a plant of 50 hp. or over; or shall have had such other practical experience as qualifies him for examination.

3. An applicant for a first-class certificate shall have at least two years' experience assisting an engineer in charge of a plant of 200 hp. or over; or shall have had charge of a plant of over 50 hp. and under 200 hp. for two years; or shall have had such other practical experience as, in the opinion of the board, qualifies him for examination.

News of Canada

Mid-Year Review by Minister of Interior Indicates Progress of Power Development in the Provinces

ONE of the most informative surveys issued in connection with the power situation in Canada is that of the Hon. Charles Stewart, Minister of the Interior, who has just made public his mid-year review of water power activities. The survey states that in the first half of the current year new developments together with existing plants have added almost 200,000 hp. to the total installation in the Dominion, while undertakings are under way which when completed to their design capacities will involve a total installation in excess of 2,000,000 horsepower.

Dealing first with Ontario, the report states that the provincial hydro commission has under way the addition of the tenth unit of 58,000 hp. capacity to its Queenston station on the Niagara River. Work has also been resumed on the 54,000 hp. plant at Alexander Landing, on the Nipigon River, which it is expected to complete in 1931. Work is also under way on a duplicate 220,000-volt line from the Gatineau developments to Toronto.

In northern Ontario two new developments have recently been completed —one of 28,200 hp. for the International Nickel Company, of Canada, at Big Eddy Dam, on the Spanish River, and the other for the Algoma District Power Company at High Falls, on the Michipicoten River. The latter has an initial installation of 18,770 horsepower.

In the Province of Quebec installations already completed during the present year include the addition of the fourth units to the Gatineau Power Company's plants at Chelsea and Farmers Rapids, of 34,000 and 24,000 hp., respectively, and of the second unit, of 25,000 hp., at the Gatineau Company's Bryson development, on the Ottawa River; the addition of unit No. 8, of 43,000 hp. to the Shawinigan Falls development of the Shawinigan Water & Power Company, and the completion of the 5,800 hp. plant of the City of Sherbrooke at Westbury, on the St. Francis River.

Construction is being actively pursued on several other large developments in Quebec. At Chute-a-Caron, on the Saguenay River, the Alcoa Power Company is making rapid progress with a development that will have an initial installation of four 65,000 hp. units scheduled for completion in 1931. The ultimate development is designed for an installation of 1,000,000 hp. On des Prairies River, near Montreal, the Montreal Island Power Company has work well advanced on a development that will have an initial installation of six 8,800-hp. units and is expected to be in operation late in the present year. The James Maclaren Company has a development actively under construction

at High Falls on the Lievre River, that is designed for an initial installation of 90,000 hp. and an ultimate capacity of 120,000 hp., the project also including a twenty-five thousand million cubic foot storage reservoir at Cedar Rapids, and a 250-ton pulp and paper mill near Buckingham.

Prospective developments in Quebec include those of the Shawinigan Water & Power Company on the upper reach of the St. Maurice River, with a projected installation of 1,000,000 hp. at three or four sites; an 80,000-hp. development by the Gatineau Power Company at Nigger Rapids, on the Gatineau River; a 30,000-hp. plant at Chats Falls, on the Ottawa River, by the Chats Falls Power Company; and the 500,000-hp. development of the Beauharnois Light, Heat & Power Company on the St. Lawrence River.

The report also gives an exhaustive digest of recent and prospective developments in British Columbia, the Prairie Provinces and the Maritime Provinces, which indicate that never before in the history of the Dominion has there been such an active program of water power development. During the next five years at least, millions of dollars will be expended in this work.

Drought Reduces Water-Power Production

Drought, which is beginning to impair agricultural prospects in many sections of the United States, is having a decided effect upon the production of electricity by water power, according to a statement issued by the statistical research department of the National Electric Light Association. During July hydro-electric energy comprised 38 per cent of the total production of electricity, as compared with a high point of 43 per cent in May, and 43 per cent in July, of the previous year. Since January 1, generation by water power has increased by only 696,000,000 kw.-hr. (or by 3 per cent) whereas generation by steam has grown by 5,206,000,000 kw.-hr. (or by 18 per cent).

Analyzed by the various sections of the country, the drop in the production of water power is striking. During the first seven months of the year, the generation of electricity by water power in New England and in the Middle Atlantic States was 3 per cent less than during the corresponding period of 1928. In Massachusetts only 34,913,000 kw.-hr. was so produced, as against 50,855,000 in July of last year, and in Maryland only 54,715,000 kw.-hr., as against 142,646,000 in the previous year. During the month business activity in these areas was considerably above the level of 1928, with the result that the demands of industry and trade (which are entirely independent of water power) required a much greater total production of electricity. This was supplied by increased operations in the steam plants of the interconnected systems, emphasizing again the dependence of water power plants.

Coming Conventions

American Institute of Electrical Engineers. District meeting at Chicago, Ill., Dec. 2-4. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Mechanical Engineers. Annual meeting at New York, N. Y., Dec. 2-6. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

National Association of Practical Refrigerating Engineers. Twentieth annual convention at the William Penn Hotel, Pittsburgh, Pa., Nov. 4-7. Secretary, E. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York City, Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York City.

New England Water Works Association. Annual convention at Hotel Eastland, Portland, Me., Sept. 17-20. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Third National Fuels Meeting at the Bellevue-Stratford Hotel, Philadelphia, Pa., Oct. 7-11.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

Bituminous Coal Market Increasing

The remainder of 1929 shows indication of an increased market for bituminous coal, according to a recent statement by the National Coal Association. If production for the remainder of the present year equals that for the same period of 1928, the output for 1929 will be approximately 517,000,000 tons. The 1928 bituminous production was slightly under 493,000,000 tons.

There is every reason to believe that this year's output will exceed that of 1928, owing to increased industrial activity and low consumers' stocks, according to the statement. The Bureau of Mines reports a 16 per cent increase in coke production for the first seven months of 1929 over a corresponding period a year ago, and revenue freight car loadings are running over 5 per cent above those for last year. Consumers' stocks are at the lowest point since 1922 and it is a safe prophesy that not only will no coal be taken from stocks but substantial additions will be made thereto.

Consumption as reported by the Bureau of Mines for the second quarter of 1929 shows a 411,000-tons-per-week increase over that for April, May and June, 1928, which alone would indicate an actual deemand of 7,000,000 tons of coal in excess of last year's needs.

Obituary

Albert E. Walden, consulting engineer of Baltimore, Md., died last week at his home in that city. Formerly chief engineer of the Baltimore County metropolitan district, Mr. Walden had been a resident of Baltimore since 1906. He was general superintendent, engineer and purchasing agent of the Baltimore County Water & Electric Company until that organization was taken over by the city. He was a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and of other technical associations.

Alfred E. McCordio, president of the Illinois Power and Equipment Company, Chicago, died on Aug. 30, in St. Luke's Hospital after a short illness. He was 67 years of age.

Edward Worcester, formerly vice-president in charge of sales of the National Tube Company, McKeesport, died Aug. 29 at Pittsburgh. He had been connected with the National company for 25 years before his resignation in 1922, having been vice-president since 1903.

Personals

Ralph E. Secord, power engineer of the Quincy (Mass.) Electric Light & Power Company, has been appointed sales manager of that utility, succeeding Herbert Southworth, who has been appointed sales manager of the Fall River (Mass.) Electric Light Company. Mr. Secord was formerly in the engineering department of Stone & Webster, Inc., and entered the employ of the Quincy Electric Light & Power Company in the fall of 1928.

A. E. Halliwell, formerly engineer in the marine department of Foster, Wheeler, Ltd., has taken up the duties of director and engineer with Phillips & Sons (Chiswick), Ltd., electrical and mechanical engineers, of 42 Waterford Road, Walham Green, S.W.6, London.

Herbert L. Seward, professor of mechanical engineering in Sheffield Scientific School, of Yale University, has been appointed assistant to Captain Charles A. McAllister, president of the American Bureau of Shipping, the United States government's official merchant ship classification society.

Edward H. Sidler has resigned as engineer in charge of the blower and compressor department of the American Brown-Boveri Electric Company and has accepted a position of manager of engineering of H. Wild's Surveying Instruments, Ltd., Heerbrugg, Switzerland.

JAMES J. P. MACKENZIE has left the Walworth Ohio Company, Cleveland, Ohio, to take a position with Hopkinsons, Ltd., of Huddersfield, England, manufacturers of safety boiler mountings and valves.

F. B. CALDWELL, vice-president of the Chicago plant of the Link-Belt Company, has resigned on account of his health. W. C. CARTER, formerly vice-president in general charge of production of all Link-Belt plants, will assume the duties of vice-president and general manager of the Chicago plant.

J. M. BARTON has severed his connections with the National Tube Company, and is now connected with the Fretz-Moon Tube Company, Inc., Butler, Pa.

BUSINESS NOTES

FOSTER WHEELER CORPORATION, New York City, announces the appointment of T. J. Cleary as manager of its Atlanta office. Mr. Cleary has been connected with the Combustion Engineering Corporation as district manager in the Southeast and was a sales engineer for the Westinghouse Electric & Manufacturing Company for a period of fifteen years.

RAMESOHL & SCHMIDT COMPANY, Oelde, Germany, manufacturers of Westfalia separators, has opened an American sales office at 110 North Franklin St., Chicago, Ill., under the firm name, Westfalia Separator Company. The new office is under the personal management of Dr. Hugo Habig, one of the officials of the home concern.

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., announces the appointment of J. B. Holston as branch manager of the St. Louis sales office. Mr. Holston was formerly located in the Chicago territory.

DUNBAR ENGINEERING COMPANY, New York City, representing the Edward Valve & Manufacturing Company of East Chicago, Ind., announces the removal of its offices from 50 Church St. to the Chanin Building, 122 East 42nd St., New York City.

GENERAL REFRACTORIES COMPANY, Philadelphia, Pa., states that only its high-temperature cements, and not all its products, as stated in this section several weeks ago, are now handled by dealers in industrial centers throughout the country. This new policy will facilitate deliveries on the high-temperature cements.

LINK-BELT COMPANY, Chicago, Ill., announces that E. J. Burnell, who was manager of the Pittsburgh office, has been appointed sales manager of the western division, and that Nels Davis, from the Chicago engineering sales force, succeeds Mr. Burnell as manager of Link-Belt Company's Pittsburgh office.

TRADE CATALOGS

FLOW METERS—The second edition of the Brown flow meter catalog, issued as No. 21, is a 90-page booklet containing a complete presentation of the general theory, use, design and practical application of flow meters, and the construction and features of the electric flow meters made by the Brown Instrument Company, Philadelphia, Pa.

REFRACTORIES — The Denver Fire Clay Company, Denver, Colo., has just published a 60-page catalog, 141-U, on fire brick, moldable furnace lining and high-temperature cements. Catalog 142-U, also recently released, describes flat-suspended arches, monolithic furnace wall construction and suspended arches for H. R. T. boilers.

BOILERS—The D. Connelly Boiler Company, Cleveland, Ohio, has recently issued an interesting catalog pertaining to its four-drum, bent-tube boilers. Fifty pages of photographs and drawings of manufacturing processes in the Connelly plant, completed installations and exterior views of power plants in which such installations have been placed are attractively presented.

DIESEL ENGINES — "Some Notable Diesel Engine Installations," a booklet of 32 pages recently put out by the Nordberg Manufacturing Company, Milwaukee, Wis., shows a number of typical Nordberg Diesel engine installations. No details of construction are included, but the economic factors connected with the success of these plants, from Long Island to Panama, is clearly brought out.

MOTORS—Bulletin 165 recently issued by Wagner Electric Corporation, St. Louis, Mo., describes the present line of Wagner squirrel-cage motors, gives a table of comparative prices and a detailed table of electrical and mechanical characteristics. Tables to aid users in choosing the proper motor are a valuable part of the bulletin.

FLEXIBLE COUPLINGS—The American Flexible Coupling Company, Erie, Pa., has recently published an attractive bulletin describing and illustrating its couplings. A table of specifications and a price list is included in the catalog, which is listed as No. 101.

BOILERS—Two bulletins, one of sixteen pages describing the "Erie City" three-drum boiler and one of twelve pages describing the "Economic" boiler, have been published by the Erie City Iron Works, Erie, Pa. Both of these catalogs contain diagrams and illustrations concerning the internal construction of these boilers.

EXHAUSTERS — The Connersville Blower Company, Connersville, Ind., has just issued a new bulletin, No. 201, describing Connersville rotary gas exhausters for service in gas plants, coke plants, oil refineries and other locations. This bulletin contains a description of the general operating principle of these exhausters and also illustrations of the products in actual service.

CLUTCHES—Bulletin No. 571 put out by T. B. Wood's Sons Company, Chambersburg, Pa., describes its Peerless unit-adjusting friction clutches. Diagrams showing construction and a table of dimensions and prices are included in the pamphlet.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.00 @ $2.35
Kanawha	Columbus	1.25 @ 1.55
Smokeless	Cincinnati	1.85 @ 2.00
Smokeless	Chicago	2.25
S. E. Kentucky	Chicago	1.35 @ 1.60
Steam	Pittsburgh	1.50 @ 1.60
Gas Slack	Pittsburgh	1.00 @ 1.10
Big Seam	Birmingham	1.50 @ 1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.50@$2.75
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Sept. 12, f.o.b., Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; 36@40 deg., furnace, tank-car lots, f.o.b., Bayway, 6c. per gal.

St. Louis—Sept. 6, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.445934 per bbl. or 42 gal.; 26@28 deg., $1.495934 per bbl.; 28@30 deg., $1.545934 per bbl.; 30@32 deg., $1.595934 per bbl.; 32@36 deg., gas oil, 4.401c. per gal.; 38@40 deg., distillate, 5.73c.

Pittsburgh—Sept. 4, f.o.b. local refinery, 30@34 deg., fuel oil, 4.5c. per gal.; 36@40 deg., 5c. per gal.

Philadelphia—Sept. 9, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Sept. 3, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5.25c. per gal.; 30@32 deg., 5.5c. per gal.

Chicago—Aug. 24, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 85c. per bbl.; 30@32 deg., $1.04½ per bbl.

Boston—Sept. 9, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.45c. per gal. 28@32 deg., 5.55c. per gal.

Dallas—Aug. 31, f.o.b. local refinery, 26@30 deg., $1.30 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ark., Russellville—City plans an election to vote $200,000 bonds for the construction of a municipal power and light plant.

Calif., Aluras—California Public Service Co., plans the construction of a new power plant. Estimated cost $100,000. W. W. Jones is engineer.

Calif., San Francisco—Hutton Co., 160 Montgomery St., is having plans prepared for the construction of a 20 story office building at Montgomery and Bush Sts. Estimated cost $1,000,000. Architect not selected.

Colo., Crested Butte — Rock Coal Co. and Western Colorado Power Co., Durango, plan the construction of a po welprant to serve mining district here. Estimated cost $800,000.

Fla., Lake Wales — J. W. Ross, Dyal Upchurch Bldg., Jacksonville, will build a 100 ton ice plant here. Estimated cost $200,000.

Fla., Mountain Lake (mail Waverly) — Mountain Lake Corp., plans the construction of a waterworks system, including wells, pump house, mains, etc.

Ga., Rockmart—Simpson & Morgan Ice & Coal Co., will build a 15 ton ice plant, electrially operated, at South Marble and Maple Sts.

Ill., Chicago—Morrison Hotel, 77 West Madison St., is having sketches made for a 22 story addition to hotel and stores building at 63-69 West Madison St. Estimated cost $3,300,000. Holabird & Roche, 333 North Michigan Ave., are architects.

La., Alexandria—Rapides Parish awarded contract for the construction of an auxiliary pumping plant in connection with excavation work at mouth of Bayou Rapides, to Clopton & Robert, Baton Rouge, La. Estimated cost $96,702.

La., Shreveport—City is having preliminary plans prepared for the construction of an 8 m.g. daily capacity pumping station in connection with waterworks. Estimated cost $450,000.

Md., Baltimore — Berliner-Joyce Aircraft Corp., Hearst Tower Bldg., awarded contract for the construction of a 1 story, 60 x 120 ft. wind tunnel and laboratory including power station with 250 hp. motor generating set, 250 hp. motor to drive 13 ft. 4 blade propeller to force air through tunnel to M. A. Long Co., 10 West Chase St.

Mass., Mattapan (Boston P. O.) — Hospital Dept., is having revised plans prepared for addition and alterations to boiler plant at Tuberculosis Hospital. Estimated cost $190,000. J. H. Ritchie & Associates, 250 Stuart St., Boston, are architects.

Mass., Worcester—M. J. Whittall Associates, awarded contract for the construction of an 80 x 110 ft. power house to Morton C. Tuttle Co., 31 St. James Ave., Boston, Mass. Estimated cost $200,000.

Minn., Minneapolis—Local Manufacturers, c/o E. S. Griffith, 743 Washington Ave. N., Chn. of Comm., plans the construction of an electric power plant to serve a North Minneapolis district. Estimated cost $100,000.

Miss., Alcorn—Building Comn., W. C. Trotter, Secy., Jackson, awarded contract for the construction of boiler and power houses at A.&M. College here to W. J. McGee & Son, Jackson. Estimated cost $10,890.

N. J., Bayonne—Jewish Hospital Association of Hudson Co., 2852 Hudson Blvd., Jersey City, plans the construction of a 4 story hospital including steam heating system, etc. at Blvd. and 9th St. Estimated cost $2,000,000. Architect not selected.

N. J., Bradley Beach—City will soon award contract for the construction of a sewage disposal plant including pumps, etc. Estimated cost $130,000.

N. J., Hillside — Dept. of Institutions & Agencies, State Office Bldg., Trenton, will receive bids about Sept. 16, for the construction of a power house here. Estimated cost $50,000. Guilbert & Betelle, 20 Branford Pl., Newark, are architects.

N. J., Newark—American Insurance Co., 70 Park Pl., awarded contract for the construction of a 21 story home office building on Broad St. to Starrett Bros. Inc., 101 Park Ave., New York, N. Y. Estimated cost $1,000,000. Steam heating and ventilation system, boilers, elevators, etc. will be installed.

N. J., Paramus—Bd. of Chosen Freeholders, Court House, Hackensack, awarded contract for the construction of a 45 x 85 ft. central heating plant here to Ferber Construction Co., 16 Johnson Ave., Hackensack. Estimated cost $27,400.

N. J., Woodbine—Dept. of Institutions & Agencies, Trenton, received lowest bid for the construction of a power house here from Camden Construction Co., Camden. $27,500.

New York—Bd. of Light Comrs., Boonville, will build and maintain for other than municipal purposes, electric light plants in towns of Leyden and Lewis, in Lewis Co., and Ava, Lee and Western in Oneida County.

N. Y., Attica—Comr. of Correction, Albany, received lowest bid for the construction of a group of buildings including power house, etc., in connection with proposed new State Prison here from John Johnson Construction Co., Inc., 765 Abbots Rd., Buffalo.

N. Y., New York—Empire State Inc., is having plans prepared for the construction of an 80 story office building at 5th Ave. and 34th St. Estimated cost $40,000,000. Shreve, Lamb & Harmon, 7 East 44th St., are architects. H. G. Balcom, 10 East 47th St., is engineer. Meyer, Strong & Jones Inc., 101 Park Ave., in charge of heating, ventilation, electrical wiring and elevator construction.

N. Y., New York—United Electric Light & Power Co., 130 East 15th St., plans the construction of a 1 story, 249 x 437 ft. boiler house and engine room at 134th St. and Locust Ave. Estimated cost $75,000. C. E. Dell, 130 East 15th St., is architect.

N. D., Grafton—City, L. Mautitson, Auditor, will receive bids until Sept. 24, for the construction of a new municipal electric power plant, steam or oil engine. Estimated cost $70,000. Druar & Milinowski, 500 Globe Bldg., St. Paul, Minn., are engineers.

Okla., Canton—E. W. Baker & Co., Medical Arts Bldg., Oklahoma City, is having preliminary plans prepared for the construction of a 10 ton raw water ice plant here. Estimated cost $25,000.

Pa., East Pittsburgh—Westinghouse Electric & Mfg. Co., is receiving bids for the construction of a 34 x 63 ft. power house, also a 3 story, 60 x 90 ft. service building on Ardmore Blvd. B. H. Prack, Martin Bldg., Pittsburgh, is architect.

Tenn., Cookeville—City voted $50,000 bonds for extensions and improvements to hydro-electric plant. J. A. Sietzer, is engineer.

Tex., Gonzales—American Produce Co. will build a cold storage and poultry dressing plant. Estimated cost $30,000. Private plans.

Tex., Mercedes—Central Power & Light Co., Frost Bldg., San Antonio, awarded contract for the construction of a 150 ton ice plant here, to R. E. Ewing, Harlingen. Estimated cost $100,000.

Tex., Pelly—City plans an election Sept. 28 to vote $60,000 bonds for the construction of a waterworks system including pumping unit, etc.

Wash., Olympia—Western Washington Electric Light & Power Co., Aberdeen, has been granted permit to divert 5,000 cu.ft. of water per sec. for North River tributary of Willipa Harbor and to construct a dam impounding 272,000 acre ft. of water here. Estimated cost $2,250,000.

Ont., Ottawa—Dept. of Public Works, awarded contract for addition to heating plant to A. J. Garvock, Sparks St. Estimated cost $82,000.

Equipment Wanted

Boiler, Pumps, etc.—Dept. of Street Cleaning, A. A. Taylor, Comr., Municipal Bldg., New York, N. Y., will receive bids until Sept. 19, for furnishing and installing a low pressure boiler, vacuum pumps and accessories together with oil burner in connection with present heating system in D. S. C. Storehouse, 2nd Ave., 32nd to 33rd St., Brooklyn.

Power Plant Equipment—Mississippi Building Commission, Jackson, Miss., will receive bids new bids for power plant equipment, etc. for University of Mississippi, Oxford. Former bids rejected.

Pump, Etc.—Village of Bridgman, Mich., F. Maoholz, Clk., will receive bids until Sept. 23 for motor driven centrifugal pump, etc. for proposed waterworks improvements.

Pumping Unit—Starr County Water Control & Improvement Dist. 1, L. Perez, Pres., Roma, Tex., will receive bids about Nov. 15 for a large River pumping unit with several small second lift plants in connection with proposed irrigation work. Total estamiated cost $1,200,000.

Industrial Projects

Conn., Stamford — FACTORY — Pitney-Downes Postage Meter Co., Pacific St., awarded contract for a 2 story, 60 x 300 ft. factory on Atlantic Ave., to E. & F. Construction Co., 94 Wells St., Bridgeport. Estimated cost $150,000.

Ill., East St. Louis—COTTON COMPRESS PLANT ADDITION—St. Louis Cotton Compress Co., 408 Federal Commerce Bldg., St. Louis, Mo., will build a 1 story, 180 x 1,980 ft. addition to cotton compress plant at Southern and Terminal Railroad tracks. Work will be done by sub-contracts under the supervision of W. J. Knight & Co., 904 Wainwright Bldg., St. Louis, Mo., Engrs.

La., Monroe—PAPER MILL ADDITIONS—Brown Paper Mill Co. Inc., awarded contract for addition to paper mill to Morton C. Tuttle Co., 31 St. James Ave., Boston, Mass. Estimated cost $4,000,000.

Mich., Detroit—AXLE PLANT—Timken Detroit Axle Co., Clark Ave., is having plans prepared for a 3 story, 80 x 120 ft. plant. Private plans. Electric motors and general equipment for finishing axles and parts will be required.

Mich., Grand Rapids—BODY PLANT—Hayes Body Corp., 551 7th Ave., N. W., is receiving bids for a 3 story, 75 x 565 ft. body plant on Muskegon St. Private plans. Electric motors, etc. will be required.

Mich., Kalamazoo—CAB FACTORY—A. Kahn, 1000 Marquette Bldg., Detroit, Archt., will receive bids about Sept. 20 for the construction of a 1 and 2 story, 320 x 505 ft. factory on South Pitcher St. for Checker Cab Co., Kalamazoo. Electric motors and equipment for dry kilns for wood body material will be required.

Mo., Maplewood — AUTOMOTIVE ACCESSORIES FACTORY—Sunnen Products Co., 6417 Dale Ave., St. Louis, awarded contract for a story, 120 x 168 ft. factory here to A. L. Sketters, Mexico, Mo. Estimated cost $65,000.

N. Y., Staten Island — OIL REFINERY — Standard Oil Co., 26 Broadway, New York, is having sketches made for the construction of an oil refinery, oil storage tanks, etc. at Kreischerville. Estimated cost $1,000,000. Private plans.

O., Cincinnati—CHEMICAL FACTORY—William S. Merrell Co., 5th and Pike Sts., plans the construction of a 2 story factory for the manufacture of pharmaceuticals and salicylic acid on Carthage Ave. Estimated cost $500,000. Tietig & Lee, 34 West 6th St., are architects.

O., Cleveland—FACTORY—Cream Cone Machine Co., T. W. Taylor, Pres., 1874 East 59th St., awarded contract for a 3 story, 57 x 65 ft. addition to factory at 5800 Hough Ave., to Leslie W. Lapp, 2020 Brunswick Rd. Estimated cost $50,000.

O., Cleveland — BRONZE FACTORY — John Harsch Bronze & Foundry Co., J. Harsch, Pres., 11612 Madison Ave., plans the construction of a 1 story factory on West 121st St. Estimated cost $75,000. Architect not selected.

O., Cleveland—WATER HEATER FACTORY—J. M. Sands Co., 5204 Sweeney Ave., manufacturers of water heaters, awarded contract for a 1 story, 65 x 68 ft. addition to factory to Bolton-Pratt Construction Co., Columbia Bldg. Estimated cost $40,000.

Ont., New Toronto—SERVICE BUILDING—Anaconda American Brass Ltd., awarded contract for foundation for a 2 story service building in connection with $500,000 expension program to Anglin-Norcross, Ltd., Temple Bldg., Toronto. Estimated cost $75,000.

Ont., Toronto—FOUNTAIN PEN FACTORY—Parker Fountain Pen Co., plans the construction of a factory on Fleet St. Estimated cost $200,000.

Ont., St. Catharines — AUTOMOBILE FACTORY — General Motors Co. of Canada, Oshawa, awarded contract for a 1 story, 120 x 480 ft. addition to factory here to W. J. Trick & Co., 25 Albert St., Ottawa. Estimated cost $175,000. Equipment for the manufacture of auto parts and specialties, will be required.

Ont., Walkerville—AUTO SPECIALTY FACTORY—Dominion Specialties Co., L. Newnham, Pres., 240 Walker Rd., plans the construction of a 1 story, 100 x 200 ft. factory on Walker Rd. Estimated cost $60,000. Private plans.